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1906.

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FRIDAY, NOVEMBER 17, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

ONE-HUNDRED-AND-FIFTY-SECOND SESSION, 1905-6.

PATRON—HIS MOST GRACIOUS MAJESTY THE KING.

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Assistant Secretary for the Indian and Co ial Sections.—SAMUEL DIGBY.

Chief Clerk.—GEORGE DAVENPORT. *Accountant.*—J. H. BUCHANAN. *Auditors.*—KNOX, CROPPER &

SESSIONAL ARRANGEMENTS.

The Opening Meeting of the One-hundred-and-Fifty-Second Session was held n Wednesday Evening, the 15th of November, when an Address was delivered by Sir OWEN ROBERTS, M.A., D.C.L., F.S.A., Vice-President and Chairman of the Council.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

NOVEMBER 22.—F. MARTIN-DUNCAN, "The Cinematograph and its Applications." PROFESSO H. E. ARMSTRONG, Ph.D., LL.D., F.R.S., will preside.

" 29.—SIR WILLIAM H. PREECE, K.C.B., F.R.S., "The British Association in S h Africa." SIR OWEN ROBERTS, D.C.L., Chairman of the Council, will pres

DECEMBER 6.—SIGMUND STEIN, "The Manufacture of Sugar from British Grown Beet." THE RIGHT HON. THE EARL OF DENBIGH, C.V.O., will preside.

„ 13.—W. F. MITCHELL, "The Commerce and Industries of Japan." HIS EXCELLENCY THE JAPANESE AMBASSADOR, G.C.V.O., LL.D., D.C.L., will preside.

„ 20.—CHARLES L. BURDICK, "The Aerograph Method of Distributing Colour."

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

DECEMBER 7.—"The Partition of Bengal." By SIR JAMES A. BOURDILLON, K.C.S.I.

December 7, January 18, February 15, March 15, April 26, May 24.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 o'clock :—

February 6, March 6, April 3, May 1.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

DECEMBER 12 (8 p.m.).—"Historical Pageants." By LOUIS N. PARKER.

December 12, January 30, February 20, March 20, April 24, May 15.

Papers for meetings after Christmas :—

"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.).
"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.
"Submarine Signalling." By J. B. MILLET.
"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.
"The Planting of Waste Lands for Profit." By J. NISBET.
"Industrial Russia." By LUCIEN WOLF.
"The Horseless Carriage, 1885-1905." By CLAUDE JOHNSON.
"The Artistic in Painting and Photography." By J. C. DOLLMAN, R.I.
"Illuminated MSS." By H. YATES THOMPSON.
"The City of Calcutta." By CHARLES EDWARD BUCKLAND, C.I.E.
"The Languages of India and the Linguistic Survey." By Dr. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit.
"Seistan : Past and Present." By COLONEL ARTHUR HENRY McMAHON, C.S.I.
"The Navigable Waterways of India." By ROBERT BURTON BUCKLEY, C.S.I.
"The Parsis of Persia." By MAJOR PERCY MOLESWORTH SYKES, C.M.G.
"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E.
"Imperial Questions in the West Indies." By SIR NEVILLE LUBBOCK, K.C.M.G.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. A. FLEMING, D.Sc., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (In continuation of previous courses on "Electric Oscillations and Electric Waves," and on "Hertzian Wave Telegraphy.") Four Lectures.

LECTURE I.—NOVEMBER 27.—*Measurement of High Frequency Capacity, Inductance, and Resistance.*—Practical methods of measuring small capacities—Capacity of Leyden jars, aërial wires, antennæ and insulated conductors—Formulæ for capacity of standard forms—Practical measurement of small inductances—Pre-determination of inductances of standard circuits—High frequency resistance—Surface distribution of high frequency currents—Methods of determining spark resistance—Methods of measuring number of sparks per second—Effect of proximity of aërial wires on their capacity and inductance.

LECTURE II.—DECEMBER 4.—*Measurement of High Frequent Voltage and Current.*—Damping of electrical oscillations—Maximum and mean-square values—The damping factor and logarithmic decrement—The resistance decrement and radiation decrement—Damping due to dielectric hysteresis and magnetisation—Methods of determining maximum and mean-

square voltage—Spark voltage in air at various pressures—Electrometer measurements—Calculation of maximum carrents during discharge—Methods of determining logarithmic decrements employed by Rutherford, Bjerknes, Drude and others—Analysis of the discharge of a Leyden jar, or condenser.

LECTURE III.—DECEMBER 11.—*Measurement of Frequency and Resonance.*—Time period and oscillation constant of a condenser circuit—Closed and open circuit syntonic circuits—Theory of resonance—Experiments illustrating resonance—Resonance curves—Determination of the total decrement from resonance curves—The Cymometer—Its use for determining small capacaties and inductances—Theory of the oscillation transformer—Analysis of the phenomena of the oscillation transformer by the aid of the Cymometer.

LECTURE IV.—DECEMBER 18.—*Measurement of Free and Stationary Wave-Length.*—Stationary waves on wires—Velocity of propagation—Mechanical model—Loops and nodes of potential and current—Special qualities of spirals—Methods of detecting loops and nodes—Radiation from aërial wires—Velocity of free waves—Relations of free-wave length to antenna length—Direct and inductively coupled aërials—Determination of the wave-length and damping of the waves radiated from antennæ—Methods of syntonising coupled circuits with the Cymometer.

SIR WILLIAM WHITE, K.C.B., F.R.S., "The Modern Warship." Five Lectures.
January 29, February 5, 12, 19, 26.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.
March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.
April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.
May 14, 21, 28.

HOWARD LECTURES.

A Course of Three Lectures will be given under the Howard Trust, by PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., on "High Speed Electric Generators, with special reference to driving by Steam-turbines," on the following Thursday evenings at 8 o'clock:—
January 18, 25, February 1.

JUVENILE LECTURES.

Wednesday Evenings, January 3 and 10, 1906, at 7 o'clock:—
"Flame and Combustion." By PROFESSOR HERBERT JACKSON, F.C.S.

CONVERSAZIONE.

The Annual Conversazione of the Society will probably be held on Thursday, June 28, 1906. Each member is entitled to a card for himself, and one for a lady.

PROCEEDINGS OF THE SOCIETY.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department or science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November, and ends in June.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

Indian Section.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

Colonial Section.—The Section was formed in 1874 under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, so as to include the consideration of subjects connected with our Colonies and Dependencies. Four or more Meetings are held during the Session.

Applied Art Section.—This Section was formed in 1886, for the discussion of subjects connected with the industrial applications of the Fine Arts. Six or more Meetings are held during the Session.

Cantor Lectures.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are several Courses every Session, and each course consists generally of from two to six Lectures.

Additional Lectures.—Special Courses of Lectures are occasionally given.

Juvenile Lectures.—A Short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

Admission to Meetings.—Members have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted by signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

Journal of the Society of Arts.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

Examinations.—Examinations, founded in 1853, are held annually by the Society, through the agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal elements of Commercial Education, and Music. Full particulars of the Examinations can be had on application to the Secretary.

Library and Reading-room.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

Conversazioni are held, to which Members are invited, each Member receiving a card for himself and a lady.

MEMBERSHIP.

The Society numbers at present between three and four thousand Members. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid. There is no Entrance Fee.

Every Member whose subscription is not in arrear is entitled:—

To be present at the Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.

To be present and vote at all General Meetings of the Society.

To be present at the Cantor and other Lectures, and to introduce one visitor.

To have personal free admission to all Exhibitions held by the Society at its house in the Adelphi.

To be present at all the Society's *Conversazioni*.

To receive a copy of the weekly *Journal* published by the Society.

To the use of the Library and Reading-room.

Candidates for Membership are proposed by Three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

All subscriptions should be paid to the Secretary, Sir Henry Trueman Wood, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him at the Society's House, John-street, Adelphi, London, W.C.

HENRY TRUEMAN WOOD, *Secretary.*

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1905-1906. It is issued subject to any necessary alterations:—

NOVEMBER, 1905.

1	W	
2	Th	
3	F	
4	S	
5	**S**	
6	M	
7	Tu	
8	W	
9	Th	
10	F	
11	S	
12	**S**	
13	M	
14	Tu	
15	W	Opening Meeting of
16	Th	the Session
17	F	
18	S	
19	**S**	
20	M	
21	Tu	
22	W	Ordinary Meeting
23	Th	
24	F	
25	S	
26	**S**	
27	M	Cantor Lecture I. 1
28	Tu	
29	W	Ordinary Meeting
30	Th	

DECEMBER, 1905.

1	F	
2	S	
3	**S**	
4	M	Cantor Lecture I. 2
5	Tu	
6	W	Ordinary Meeting
7	Th	Indian Section
8	F	
9	S	
10	**S**	
11	M	Cantor Lecture I. 3
12	Tu	Applied Art Section
13	W	Ordinary Meeting
14	Th	
15	F	
16	S	
17	**S**	
18	M	Cantor Lecture I. 4
19	Tu	
20	W	Ordinary Meeting
21	Th	
22	F	
23	S	
24	**S**	
25	M	CHRISTMAS DAY
26	Tu	*Bank Holiday*
27	W	
28	Th	
29	F	
30	S	
31	**S**	

JANUARY, 1906.

1	M	
2	Tu	
3	W	Juvenile Lecture I.
4	Th	
5	F	
6	S	
7	**S**	
8	M	
9	Tu	
10	W	Juvenile Lecture II.
11	Th	
12	F	
13	S	
14	**S**	
15	M	
16	Tu	
17	W	Ordinary Meeting
18	Th	Indian Section Howard Lecture. 1
19	F	
20	S	
21	**S**	
22	M	
23	Tu	
24	W	Ordinary Meeting
25	Th	Howard Lecture. 2
26	F	
27	S	
28	**S**	
29	M	Cantor Lecture II. 1
30	Tu	Applied Art Section
31	W	Ordinary Meeting

FEBRUARY, 1906.

1	Th	Howard Lecture. 3
2	F	
3	S	
4	**S**	
5	M	Cantor Lecture II. 2
6	Tu	Colonial Section
7	W	Ordinary Meeting
8	Th	
9	F	
10	S	
11	**S**	
12	M	Cantor Lecture II. 3
13	Tu	
14	W	Ordinary Meeting
15	Th	Indian Section
16	F	
17	S	
18	**S**	
19	M	Cantor Lecture II. 4
20	Tu	Applied Art Section
21	W	Ordinary Meeting
22	Th	
23	F	
24	S	
25	**S**	
26	M	Cantor Lecture II. 5
27	Tu	
28	W	Ordinary Meeting

MARCH, 1906.

1	Th	
2	F	
3	S	
4	**S**	
5	M	
6	Tu	Colonial Section
7	W	Ordinary Meeting
8	Th	
9	F	
10	S	
11	**S**	
12	M	Cantor Lecture III. 1
13	Tu	
14	W	Ordinary Meeting
15	Th	Indian Section
16	F	
17	S	
18	**S**	
19	M	Cantor Lecture III. 2
20	Tu	Applied Art Section
21	W	Ordinary Meeting
22	Th	
23	F	
24	S	
25	**S**	
26	M	Cantor Lecture III. 3
27	Tu	
28	W	Ordinary Meeting
29	Th	
30	F	
31	S	

APRIL, 1906.

1	**S**	
2	M	Cantor Lecture III. 4
3	Tu	Colonial Section
4	W	Ordinary Meeting
5	Th	
6	F	
7	S	
8	**S**	
9	M	
10	Tu	
11	W	
12	Th	
13	F	GOOD FRIDAY
14	S	
15	**S**	EASTER SUNDAY
16	M	*Bank Holiday*
17	Tu	
18	W	
19	Th	
20	F	
21	S	
22	**S**	
23	M	Cantor Lecture IV. 1
24	Tu	Applied Art Section
25	W	Ordinary Meeting
26	Th	Indian Section
27	F	
28	S	
29	**S**	
30	M	Cantor Lecture IV. 2

MAY, 1906.

1	Tu	Colonial Section
2	W	Ordinary Meeting
3	Th	
4	F	
5	S	
6	**S**	
7	M	Cantor Lecture IV. 3
8	Tu	
9	W	Ordinary Meeting
10	Th	
11	F	
12	S	
13	**S**	
14	M	Cantor Lecture V. 1
15	Tu	Applied Art Section
16	W	Ordinary Meeting
17	Th	
18	F	
19	S	
20	**S**	
21	M	Cantor Lecture V. 2
22	Tu	
23	W	Ordinary Meeting
24	Th	Indian Section
25	F	
26	S	
27	**S**	
28	M	Cantor Lecture V. 3
29	Tu	
30	W	Ordinary Meeting
31	Th	

JUNE, 1906.

1	F	
2	S	
3	**S**	WHIT SUNDAY
4	M	*Bank Holiday*
5	Tu	
6	W	
7	Th	
8	F	
9	S	
10	**S**	
11	M	
12	Tu	
13	W	
14	Th	
15	F	
16	S	
17	**S**	
18	M	
19	Tu	
20	W	
21	Th	
22	F	
23	S	
24	**S**	
25	M	
26	Tu	
27	W	Annual General Meeting
28	Th	*Conversazione*
29	F	
30	S	

The Cantor Lectures will commence at Half-past Four or Eight o'clock.

The Ordinary Meetings will commence at Eight o'clock.

The Meetings of the Indian Section and the Colonial Section will commence at Half-past Four o'clock.

The Meetings of the Applied Art Section will commence at Half-past Four or Eight o'clock.

The Annual General Meeting will be held at Four o'clock.

The Juvenile Lectures will be given at Seven o'clock.

NOTICES.

SOCIETY OF ARTS EXAMINATIONS, 1906.

Medals and Prizes.

The following new Regulations will come into force at the next Examinations, April, 1906.

No Prize or Medal in any subject will be awarded to anyone who is now, or has acted as, a teacher in that subject; and no teacher at any Institution where an Examination Centre exists will be admitted to examination at that Centre.

No Prize or Medal in any subject will be awarded to any person over the age of 23 whose profession or occupation is connected with that subject, unless he or she has been a regular attendant at a class for instruction in the subject of examination during the twelve months preceding the date of examination.

The Council of the Society of Arts will be the sole judge in each individual case of the qualifications of the candidate to receive a Prize or Medal.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Monday afternoon, 13th inst. Present: Sir William Lee Warner, K.C.S.I., in the chair; H. M. Birdwood, C.S.I., LL.D.; F. C. Danvers; Henry Luttmann-Johnson; John David Rees, C.I.E.; Sir Owen Roberts, D.C.L.; Alexander Rogers; Carmichael Thomas; Thomas H. Thornton, C.S.I., D.C.L.; Sir Raymond West, K.C.I.E., LL.D.; W. Martin Wood, with S. Digby, Secretary of the Section.

The arrangements for the coming session were considered.

REPORT ON LEATHER FOR BOOK-BINDING.

The enlarged and illustrated edition of the Report of the Committee on Leather for Bookbinding is now ready. It is published by Messrs. George Bell and Sons, of York-house, Portugal-street, W.C., at the net price of 10s. 6d. Members of the Society requiring a copy can obtain one, at a discount of 25 per cent., by applying direct to the Secretary of the Society.

The whole of the report has been re-cast, and a good deal of it has been re-written. Considerable additions have been made to the portion dealing with the preparation of leathers for bookbinding, and there is an additional appendix dealing with the fading of colour from dyed leathers. There are eleven coloured plates—the frontispiece showing examples of binding in morocco and calf executed during the last fifty years showing the strongest evidence of decay. Of the remaining coloured illustrations eight show the effect of light, gas fumes, moisture, and other destructive agencies upon leather, and also the effects of light upon leather dyed with various dyes. All these illustrations have been reproduced photographically by the three-colour process, and are as near fac-similes as it is possible to obtain of the original examples. The specifications for binding books which formed a part of the original report are now fully illustrated with woodcuts, and there are some further illustrations showing the strengths of leather treated in various manners, &c.

Twelve samples of leather prepared in accordance with the conclusions of the committee's report are given in the cover. These have been kindly supplied by Messrs. J. Meredith-Jones and Sons, Wrexham; Messrs. Edw. and Jas. Richardson, Newcastle-on-Tyne; and Messrs. John Muir and Sons, Beith, N.B.

PROCEEDINGS OF THE SOCIETY.

Wednesday, November 15th, 1905; Sir Owen Roberts, M.A., D.C.L., F.S.A., Vice-President and Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Adams, Herbert Jordan, J.P., Roseneath, London-road, Enfield, Middlesex.

Adams, Thomas, Puncharden-hall, Willian, Herts.

Addison, William Henry, Kimberley, Cape Colony, South Africa.

Agnew, Lieut.-Colonel John Vans, I.A., Barnbarroch, Whauphill, N.B.

Allardice, Lieut. William McDiarmid, 14, Newbold-terrace East, Leamington Spa.

Andrews, Francis Emile, Normandie, Newport-road, Cardiff.

Andrews, George F., care of Messrs. Brown Bros. and Co., 59, Wall-street, New York City, U.S.A., and Algiers, Algeria.
Bates, Eneas Percy, B.A., Southwell-villa, New Holland, Hull.
Begg, Alexander Hood, Messrs. Guthrie and Co., Penang, Straits Settlement.
Bennett, F. Dillon, M.R.C.S., L.R.C.P., 34, Weymouth-street, W.
Bolton, George Wilson, A.M.I.Mech.E., The Harbour Works, Colombo, Ceylon.
Bourdillon, Sir James Austin, K.C.S.I., Westlands, Liphook, Hants.
Burkitt, Frank, 8 and 10, Lant-street, Borough, S.E.
Calisch, Lionel, 12, Pembridge-gardens, W.
Calkin, Arthur, 29-33, Heddon-street, W.
Cartner-Dyer, John, 2A, Whitehall-court, S.W., and Cape Town, South Africa.
Chand, Rai Bahadur Gokal, Civil Surgeon, Muzaffargarh, Punjab, India.
Cheesman, Edmund Morton, 63, Railway-street, Durban, Natal, South Africa.
Chenhall, John S., 25, Cecil-road, Seaforth, Liverpool.
Cheyne, Charles August, Heilbron, Orange River Colony, South Africa.
Claxton, Harold, Westville, Crawley, Sussex.
Coats, J. Munro, 26, Upper Brook-street, W.
Contractor, Shivakshaw Hormusji, New Foras-road, Taredeo, Bombay, India.
Cooke, Arthur Clement, 9, Minster-road, West Hampstead, N.W.
Cooper, Frank, R.N.R., 39, Newick-road, Clapton, N.E.
Dâni, Purushottam Ganesh, B.A., 5, Girdlers-road, Brook-green, W.
Das, Gopal Bulhub, M.A., B.L., Gaya (E.I.Rly.), Bengal, India.
Davies, David, Plâs Dinam, Llandinam, Montgomeryshire.
Derwent, Henry C., "Bradford Daily Telegraph," Bradford.
Douglas, Robert H., I.C.R.C. "Kai-Pan," care of Commissioner of Customs, Kowloon, Hong Kong, China.
Edwards, John, Boys' High School, Grahamstown, Cape Colony.
Egerton, His Excellency Sir Walter, K.C.M.G., Government-house, Lagos, West Africa.
Ferguson, Wilfred Henry, 4, Thornwood-terrace, Partick, Glasgow.
Freyberg, Herbert, 24, Cromwell-place, South Kensington, S.W.
Fuchs, Emil, M.V.O., Abbey-lodge, Park-road, Regent's-park, N.W.
Fulton, Otto, F.R.P.S., African-house, High-road, Chiswick, W.
Gage, Captain Andrew Thomas, M.A., M.B., I.M.S., Royal Botanic-garden, Sibpur, Calcutta, India.
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The Chairman delivered the following

ADDRESS.

The Society of Arts was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of Arts, Manufactures, and Commerce," and it concerns itself with every form of intellectual effort connecting Science and Art with the mercantile and industrial progress of the nation. Taking, therefore, as my text to-night "Arts, Manufactures, and Commerce," I propose to sketch briefly the story of our industrial development from early times, and to recapitulate in a general way the steps which our Society has taken, more especially since its incorporation, in quickening the life of the nation on its material side. I start from the time when our English people—enriched and replenished from time to time by new strains of blood, and having succeeded in attracting the most energetic and enterprising as well as the most skilled craftsmen from neighbouring countries — laid the foundation of our industrial and commercial supremacy. This supremacy England has now enjoyed for a long period, and will, I am confident, continue to enjoy — although not so preponderatingly perhaps — so long as it combines excellence of industrial organisation and sustained enterprise in initiating and assimilating the new discoveries of science which underlie industrial problems with the pristine intelligence and character of its operatives, and so long as the great associations of organised labour are inspired by that moderation and prescience of dangers from international competition which has been displayed by those who control or influence the counsels of the great cotton industry of Lancashire.

In the eleventh and twelfth centuries England was almost entirely an agricultural country. The Manor system of those times contained the germs of our modern social and industrial life and organisation, and from it may be traced the gradual evolution of agriculture, industry and trade, to their existing proportions. Painfully but surely, on the decay of villenage, came the growth of free labourers and the commutation of labour rents for money payments, which ultimately made the free flow of labour and capital to different parts of the country possible. The Black Death of 1348 put a check on the rising prosperity of the country, and the Statute of Labourers of 1350 was the first of successive attempts to regulate wages by means of Acts of Parliament, and the popular discontent consequent thereon found expression in the revolutionary preaching of John Ball and the "Vision of Piers the Plowman." In course of time the serfs became copyholders, and the nucleus of a free tenantry and a "bold peasantry" was insensibly formed. Meanwhile new influences had arisen which had become important elements in moulding economic conditions in towns which also painfully but surely forced themselves into comparative independence and freedom. The reign of the Guilds had begun. The trade Guilds of the Middle Ages were undoubtedly the most important factors and features in urban economic life, and owing to the circumstance of my long personal connection—of nearly 40 years—with not the least progressive of the great Livery Companies of the City of London, I may be pardoned perhaps for dilating somewhat on their influence on the rise of trades and manufactures, and I will also touch, later, on the services which many of them have rendered to the cause of industrial education in these latter days.

The designation of "Livery" Companies recalls the days when each trade, profession, calling, and degree in life wore its distinctive costume. Possessing a close analogy to the "collegia opificum" which existed under the Roman Empire, they more probably took their origin out of the religious and social Guilds which existed in London and other towns in Saxon and early Norman times. A vast number of these Guilds and fraternities existed in early times throughout Europe, and in this country every village and hamlet had a Guild of some kind or other.

Guilds have in fact played an important part in the history of civilisation. They have fostered our arts and sciences, developed and

extended our commerce, and in many cases cherished and preserved our liberties. They have likewise in many respects moulded our national character and institutions. In the archives of the "Guildhall," the name of which suggests their original connection with the Municipality of London, may be found notices of a "Frith Guild" and a "Knighten Guild," the main objects whereof were the relief of poverty and the performance of masses for the dead. The following are the ordinances of one of these associations, framed in the thirteenth century:—

"All the bretheren and sisteren shall go in procession on the feast of Corpus Christi. . . . If any one of the Guild falls into poverty, which God forbid, and has not the means of support, he shall every week have sevenpence out of the goods of the Guild. . . . If any one dies in the City without the means of burial, the Guild shall find the means according to the rank of him who is dead. . . . If any one wishes to make a pilgrimage to Jerusalem each brother or sister shall give him a penny, if to Rome a halfpenny; and they shall go with him outside the gates of the City, and on his return they shall meet him and go with him to his mother church. . . . If a brother or sister dies outside the City on pilgrimage or elsewhere, they shall do for his soul what would have been done if he had died in his own parish. . . . When one of the Guild dies he shall, according to his means, bequeath five shillings or what he will to the Guild. . . . On feast days the bretheren and sisteren shall have three flagons and six tankards with prayers, and the ale in the flagons shall be given to the poor who most need it. After the feast a mass shall be said and offerings made for the souls of those who are dead."

Most of these rules became obsolete as a consequence of the Reformation, but the legacies of "five shillings or what he will"—and that was often something very substantial—invested in house property in the City, which has vastly increased in value are the origin of the Livery Companies' present estates. Each industry had its own quarter of the city. Thus Paternoster-row contained the sellers of beads for prayers, the Poultry poulterers, Ironmonger-lane ironmongers, the Vintry wine sellers, Cordwainer-street shoemakers, and so on. But, as membership was hereditary and transmissible to females, the Guilds always contained members apart from their titular trades.

These guilds, or new societies formed by the grouping of some of them together, received Charters of Incorporation in the reigns of Edward III., Richard II., and Edward IV., and as the twelve "great" and the many "minor" Livery Companies of London, have had their charters renewed by succeeding sovereigns down to the accession of the House of Hanover. The terms of the charters often refer to the relief of poor members as one of the objects of the incorporation. Their principal effect, however, was to organise the trade and manufactures of mediæval London, by giving the companies power (1) to compel all engaged in the trades then incorporated to join; and (2) to search for and destroy defective wares within a radius of three miles or so from St. Paul's.

For two or three centuries the Livery Companies of London thus organised, acting in concert with the merchants of "the Staple" in the provincial towns, and on the Continent—in towns such as Calais, the Germanic Hanse Towns, Bordeaux, and other seaboard towns and ports of the Continent—and giving advice to and receiving directions from the Privy Council as to mercantile policy, controlled and developed the nascent trade and manufactures of England. The Baltic ports northwards, Bordeaux southwards, were the furthest points to which English ships then sailed. The principal products of the country at that time were wool in an unmanufactured state, and woollen goods. The "wools of England"—called by the King in the "Ordinance of the Staple"—"the sovereign merchandise and jewel of our realm," were to England then what wine is now to France, what gold has been to California, Australia, and South Africa. Sheep farming was found to be lucrative by the Cistercian monasteries of Yorkshire, and by many of the landed aristocracy and gentry; and the art of weaving was taught by the fugitive Walloons, who had found an asylum from religious persecution in London and the eastern counties.

In addition to "clothworking," the smelting of iron (of which the wealds of Kent, Sussex, and Surrey furnished an abundant supply), the making of armour and bows, the latter from the wood of the forests which surrounded London; the working of silk and leather, and the manufacture of the precious metals, were all practised with much success in London. The English capital became at once a great manufacturing town and the chief port of Northern Europe.

The monopolies of the companies, however, and their powers of search were always of doubtful legality, and their constitution being

only suited to a limited area, the spread of London beyond its walls and the growth of the great suburbs, particularly those of Southwark and Westminster, seriously interfered with their efficiency as superintendents of production. The disappearance of villenage too, and with it that of the mediæval theory of *status* as the basis of the relations of master and servant and of employer and employed, of which the companies were a part and an embodiment, tended to weaken their authority. The spread of the doctrines of Wycliffe also strongly tended to bring their religious observance into desuetude.

The Livery Companies never at any period of their history expended other than a trifling proportion of their revenues on any purely trade purposes even in the time when the trades organisation was in a more or less vigorous activity. Little or nothing was ever left or given for purposes connected with trade. Moreover, even such expenses out of the corporate funds as may be said to be connected with the trades, were petty disbursements on account of searches for "evil wares," including the cost of a dinner at a tavern or the corporate hall after the day's inspection.

The many trade Acts of Parliament of Queen Elizabeth's reign indicate the decay of the Guilds trade organisation, as is well explained and illustrated in a famous passage in the first volume of Froude's "History of England," written at a time when the Livery Companies had sunk into a lethargy from which they have long ago recovered.

In addition to the exercise of a generous hospitality and the appropriation of a considerable proportion of the wealth which has accrued to them mainly during the last thirty years, but which is no longer increasing, the Livery Companies now devote large sums not only in furtherance of technical or trade education, but also to purposes of acknowledged public utility, including substantial contributions to the numerous Mansion-house funds set on foot in all cases calling for national and international compassion and sympathy, and they are in no way behind their ancestors in their recognition of the maxim that property—and especially Corporate property—has duties and responsibilities to the public which allows and acknowledges its privileges.

There are Guilds still extant—although not so rich and important as those of London—at Coventry, Chester, Newcastle, York, Norwich, and Exeter, and the Merchant Venturers' Society of Bristol, the Cutlers' of Sheffield, and the Merchant Company of Edinburgh, are not inferior in wealth and importance to the great companies of London. On the Continent few are left. Those of France were dissolved during the Revolution, and in almost all other continental countries the Guilds have disappeared. Traces of their former existence are still to be met with in the "merceries" of Augsburg and Venice, but Berne is I believe the only European capital besides London in which these stately corporations, with their mediæval tradition of charity and hospitality, survive.

The citizens of London and the Guilds thereof were always fond of public pageants and processions, in which each Guild vied with the others in the splendour of its livery and other emblems of the dignity of labour. So Chaucer writes:—

> "An haberdasher and a carpenter,
> A weaver, a dyer, and a tapiser
> Were all yclothed in a liverie
> Of a solemne and great fraternitie.

The Lord Mayor's Show may be considered a survival of the pageants and processions which were comparatively frequent in the Middle Ages when London streets were picturesque, if narrow, and by no means congested with traffic and pedestrians as nowadays.

In these early days, however, the trade Guilds unquestionably did a great deal to foster the rising industry of the country, more especially in London and the provincial capitals. Modern conditions of trade were then non-existent and industrial problems were very different from those of to-day. The Guilds lost their influence as supervisors and directors of industry when the economic activities of the country outran their capacities to deal with them. Labourers grew up outside their jurisdiction and sphere. The main principles underlying the trade Guilds organisation are, however capable of application to modern conditions, and it cannot be denied that England owes a great debt to the London Livery Companies in the gradual evolution of British Industry, culminating in due time in its being relieved of regulations and restrictions no longer wholesome or necessary. The most potent influence in trade or craft education organised by the Guilds was the system of Apprenticeship. The apprentice was received into his master's house as a member of the family, and the master was responsible for his apprentice's good behaviour. The system, therefore, ensured not

only good technical training, but also formation of character, and its influence in this latter respect, as has been truly said, cannot be over-rated. Under the regulations of the Livery Companies, when an "industrious apprentice" had passed through the "seven long years" of his apprenticeship, he had to undergo at the close thereof what we should now call a Technological Examination, before the Master and Wardens of his Company, in the particular trade or "mystery" to which he had served. On coming out of his time he was subjected to a practical test of efficiency in his craft. He was required to execute a "masterpiece," and on his executing that masterpiece satisfactorily he was admitted to the Freedom of his Company as a master-craftsman. The ceremonies attendant on the binding and Freedom of an apprentice were very solemn, and no one was admitted to the practice of a trade unless the Guild authorities were satisfied as to his moral character, as well as his efficiency as a workman.

Turning away from the Guilds and their influence on our infant industries, and passing over monopolies granted to private individuals and other reactionary economic measures of the Stuarts, we come to the transformation of industry which began in the latter half of the eighteenth century as a consequence of the application of machinery to manufactures, commonly known as the Industrial Revolution, which coincides approximately with the date of the foundation of the Society of Arts—1754.

The wars of the early part of the eighteenth century distracted attention from industrial problems, but during the short breathing space which followed the quelling of the Jacobite rising of 1745, and the Peace of Aix-la-Chapelle in 1748, certain long-sighted men joined together to form a society to foster arts (including fine arts), agriculture, and commerce. At this time the state of the country was gloomy in the extreme. Large tracts of waste land were undrained, many districts were denuded of trees, internal communication was bad, food was scarce, and riots were common. The resources of the country were strained to their utmost and distress was widely spread. British manufacturers depended for their supply of yarn upon the hand-spinning of peasants, linen came largely from Germany and Holland, and silks from Italy and France. National art was discouraged; in the higher qranches of the fine arts foreign painters only were acknowledged, and in the lower, pottery of the coarsest kind only was produced.

The patriotic founders of the Society of Arts set themselves to remedy this state of things. William Shipley, a drawing master, issued from Northampton, on June 8th, 1753. "Proposals for raising by subscription a fund to be distributed in premiums for the promoting of improvements in the liberal Arts and Sciences, Manufactures, &c." This suggestion was fortunate in obtaining the support of Lords Folkestone and Romney, who subsequently became the first two Presidents of the Society, and on March 22nd, 1754, a meeting was held at Rawthmell's Coffee-house, in Henrietta-street, Covent-garden, at which meeting the Society was formally constituted.

The idea of such a premium-giving Society caught the public taste, the influx of members was considerable, and imitations of it were started. As early as 1755, a branch Society of Arts was formed in Brecknockshire, and a Mr. Charles Powell suggested the formation of such a society in every county which should report to the national—or central—society in London. Mr. Powell considered that this federation of societies would make England one of the most flourishing kingdoms in the world. We have here a very early acknowledgment of the national character of our (London) Society, but the most remarkable instance of the flattery included in imitation came from Russia. Catharine II. was so much pleased with the account of the premiums offered by the Society of Arts that she founded at St. Petersburgh in 1766 the "Free Economical Society" to carry out a similar object. The Society of Arts became the fashion, and the membership was equally sought for by the world of fashion as by the workers in various arts. It had great influence and accomplished a great deal of good work. At its foundation the scope of its action was very extensive, and this catholicity of character it has preserved throughout its career. It started with the following departments:—

1. Colonies and Trade. 2. Agriculture. 3. Polite Arts and Literature. 4. Minerals and Chemical subjects. 5. Mechanics and Manufactures.

His Majesty's "Colonies and Plantations abroad" were then practically all situated in North America. It did much to encourage the development of these young communities, and when, in 1755, Benjamin Franklin was elected a corresponding member, he, in acknowledging the compliment, expressed

his wish to assist in the giving of "premiums for some improvements in Britain, as a grateful though small return for your most kind and generous intention of encouraging improvements in America."

For many years the Society was the chief agricultural institution in this country. Its earliest transactions, indeed, were published as "Memoirs of Agriculture." The celebrated Arthur Young was a member, and his portrait is included in the picture of the Society by Barry on these walls. In fostering the plantation of trees the Society not only hoped largely to increase the supply of timber but also to convert many a barren mountain and swamp into a productive area.

The Society also took the place now filled by the Royal Academy. It promoted exhibitions of paintings, and encouraged youthful artists by the award of prizes. The number of celebrated artists who in their youth obtained "premiums" is very considerable, and among the noted names may be specially mentioned: Richard Cosway (afterwards R.A.), John Flaxman, Bacon, Nollekens, Banks, Romney, Bewick, and in later years, Mulready, Landseer, Frith, Hook, and Millais.

As the Chemical Society was yet to be founded (it was started in 1841, by a meeting held in this room), the Society of Arts had to include chemistry in its scope. Even then it was chiefly industrial Chemistry which was considered, and immediately after the formation of the Society premiums were offered for the discovery of cobalt and for the growth of madder.

Lastly, it had to undertake the duties now so well discharged by the great Engineering Institutions. Many important mechanical inventions received recognition at the hands of the Society, but owing to a mistaken view which led to the refusal of any award to any patented invention, many of the most important inventions of the eighthteenth century were excluded from its prize lists.

In relation to the later development of the Society's work in the establishment of examinations in languages, it is particularly interesting to find in the first volume of "Transactions," a notice of the offer of a gold medal for teaching German, Spanish, and Italian, these "being commercial languages not usually taught at schools in England." National exhibitions of art and industry seem to have been initiated by the Society of Arts, which, in 1851, was the parent of international exhibitions. The first exhibition of pictures by native artists was held in 1760, and even earlier industrial exhibitions had been held in the Society's rooms—of Manufactures in 1756, and of Agricultural Implements in 1761.

The means adopted by the Society of Arts for the promotion of the prosperity of the country, though well adapted for the needs of the eighteenth century, had to a great extent lost their power and effect in the nineteenth century. In spite of all that it had done in the past the Society lost its hold upon the public, and for some years it continued to struggle on without much success. Still, even during this interval much of interest to us was undertaken, and such national movements as those of the Duke of Bridgewater for the advancement of inland navigation, and that of Greathead, for the protection of life by the use of lifeboats, were not overlooked. An interesting incident of its history at this time was its reception of the labours of William Sturgeon, who has been proved by Professor Silvanus Thompson to be the original inventor of the electro magnet. His first paper on the invention was read in 1825, and the Silver Medal of the Society and a premium of thirty guineas were awarded to him for it.

In 1842 a change was made in the proceedings of the Society. Hitherto the business at its meetings had been for the most part confined to the investigation of the merits of inventions sent in for award, but this was work rather for small committees than for public meetings, and the natural result was that the meetings of the Society of Arts ceased to attract public attention. The practice introduced early in the centuy by Arthur Aikin of giving popular lectures on scientific and industrial subjects had proved very successful, and it was now still further developed. It was arranged to receive communications on any subject of novelty and interest connected with the arts and manufactures of the country, including patent inventions, to be read or explained with models and drawings at the Wednesday evening meetings. The first Council was appointed in 1845, and in 1847 the Society was incorporated by Royal Charter.

H.R.H. the late Prince Consort had been elected President in 1843, and his interest in the objects of the Society and his great influence made success in its new field of action assured. Fresh life was infused into all departments of the work, and the Society continued to initiate many important movements, but in nothing has its beneficial action been more marked than in its connection with

the two great subjects of "Exhibitions, National and International," and "Education." Exhibitions had been common in France for many years, and as early as 1798 an Exhibition of Works of Art and Industry was opened in Paris. I have already alluded to what was done by the Society of Arts earlier in the eighteenth century, but more important and ambitious efforts were to follow. In 1846 prizes were offered to manufacturers and designers for the production of articles of every day use, and the exhibition of the objects of decorative art sent in in response to the offers in 1847, 1848, and 1849 proved very attractive. An important exhibition of mediæval art was also arranged in 1850. The success of these exhibitions led the way for the first great Exhibition of 1851. A great national Exhibition of the products of British industry was originally proposed, and the proposal was warmly supported by the Prince Consort, various places, such as Somerset-house, Trafalgar and Leicester-squares being suggested as sites. I may mention that the father of the present Lord Chief Justice, Mr. Thomas Webster, Q.C., was one of the most earnest advocates of the scheme.

In February, 1849, M. Buffet proposed that the French Exhibition of that year should be international, but his proposal was rejected. Mr. (afterwards Sir) Henry Cole was the moving spirit in all the arrangements for the exhibitions already mentioned, and when he asked at a meeting of the Committee in June, 1849, whether the English exhibition should be national or international, the Prince Consort at once answered, "International, certainly," and the minute as corrected in that sense by His Royal Highness is now in the possession of the Society. The original conception of the exhibition of 1851 was due entirely to the Society of Arts, but it was soon found to be too large an undertaking for a private Society like this, and in January, 1850, a Royal Commission was appointed. The Exhibition of 1851 was, as we all know, not only a brilliant success in itself but also marked a turning point in the industrial history of the world. It taught the rest of Europe to estimate correctly England's great position in the production of manufactures, and it also taught our English people how backward our position in art was in comparison with that displayed in the art productions of other countries. It awakened the slumbering art faculties of our people and showed us the necessity for special education. On the other hand it gave our trade rivals much valuable information, and many hints which they were not slow to turn to account.

The International Exhibition of 1862 was likewise originated by the Society, but it would lead me too far from the object which I have mainly in view in this address to do more than allude generally to the many subsequent exhibitions with which the Society of Arts has been more or less connected.

The Society's enlarged action in connection with Education grew directly out of the Exhibition of 1851. Mr. Harry Chester, a vice-president of the Society, and subsequently Chairman of the Council, proposed in November, 1851, that a Union of Institutions should be established in connection with the Society, and in his letter on the subject he wrote:—"The Exhibition has given us some very significant hints that it is not only the education of our poor children that needs to be improved; high and low, rich and poor, old and young, have all an education question to be solved, have all a very real and urgent need of knowledge." Mr. Chester's proposal met with approval, and some conferences were held on the subject, the result of which was that a scheme of Examinations was published by the Society in the Spring of 1854. It was not, however, until 1856 that the Examinations were commenced, and in that year fifty-two candidates were examined in the Society's house. In 1857 the first attempt at provincial examinations was made, and an examination was held at Huddersfield as well as in London. In 1858 the system of appointing local committees to supervise examinations from a single centre, which has ever since been adhered to, was elaborated. It may be noted that although the Society was thus early in the field the College of Preceptors had commenced local examinations in 1853. To what remarkable proportions our system of examinations has now grown you all know.

It may be pertinent here to recall the fact that the present system of Technological Examinations carried out by the City and Guilds of London Institute, with the foundation of which the late Sir Frederick Bramwell—then Prime Warden of the Goldsmiths' Company, and an active member of this Council for many, many years—and I myself had a great deal to do, owes its origin to the Society of Arts.

In 1873, Colonel (afterwards Sir John) Donnelly submitted to the Council of the Society of Arts detailed proposals for establishing examinations and tests in the

technology of arts and manufactures based on the precedent and analogy of the Science and Art Examinations not long before established by the department of which Sir John Donnelly was for many years the director and presiding genius. The "payments on results"—obtainable in connection with the pure Science and Art Examinations were wanting as regards the new Technological Examinations, and the Clothworkers' Company voted on my recommendation—as I am proud to remember—a subsidy of £200 towards a fund for providing such payments on results, the absence of which would have been prejudicial to the experiment. This subsidy was continued and augmented until 1879, when the Technological Examinations were finally transferred to the City and Guilds of London Institute, under whose auspices and under the direction of Sir Philip Magnus, a member of this Council, they have likewise attained to phenomenal proportions and results.

I date my own connection with the Society of Arts from that year, and I have continuously since borne office as Treasurer or Vice-President. The Technological Examination conducted on the conclusion of apprenticeship by the Master and Wardens of the various Livery Companies in the time of the Citizen King Edward IV., was very different, of course, from the Technological Examination carried on under the Livery Companies in the time of Edward VII., through the agency of gentlemen practically conversant with the industries, and also scientifically conversant with the principles underlying those industries. Science and Art have now penetrated into corners of industry which in times past were never dreamt of, and those Technological Examinations have consequently been altered in character, but in their intent and object I submit that they are essentially the same.

In order that trade shall flourish, it is necessary that it shall adapt itself to the ever-growing applications of science and art—hence the necessity for technological teaching and examinations; but in addition it is necessary for us, if we wish to retain our hold on the commerce of the world, to promote commercial education. We must never forget, moreover, that Londoners and London are more concerned as distributors than as producers of commercial commodities, although London has many more manufacturing activities than is ordinarily supposed. London's enormous size prevents our realising adequately its productive as well as distributive forces. We cannot see the trees for the wood. Owing largely to the influence of the Society of Arts, Chambers of Commerce, and other such bodies, commercial education—*i.e.*, secondary education culminating in special preparation for commercial life—is at last receiving more adequate attention at the hands of the State and of the Municipalities. We must undertake the systematic study for commercial purposes of the languages of our foreign customers—among which must be included not only Spanish, Portuguese, and Italian, having reference to the colonisation of South America with its vast potentialities for commerce by Europeans speaking those languages, but under the pressure of unpleasant contemporary symptoms of industrial warfare—also Russian and the great Oriental languages, such as Chinese and Japanese, and the languages of other countries hitherto taken into small account.

Distribution, let us remember always, is no less necessary than Production, for the need of understanding the wants and peculiarities of the markets of the world is too frequently overlooked. The teaching of languages as a help to the distributor is as important as technical instruction is to the producer. Commercial, as well as technical education are both among the chief questions of the day. So we require commercial examinations and tests in modern languages, and these are supplied by the Society of Arts, which has introduced of late years a system of vivâ-voce examinations. It is a sign of the times also that certain modern Universities have created a faculty of commerce and that conversancy with two or more foreign languages—spoken as well as written—is a *sine quâ non* for a Degree in that Faculty.

I have endeavoured to point out that though the prime aim of educating the public for the good of the whole country must always be present to our minds, methods must be changed as the world changes, and now the world changes more rapidly than it ever did before. The time at my disposal will not allow of more than an indication of what has been done. The London Guilds and the Society of Arts, in alliance and co-operation, have, with similar aims, done a great work, but we cannot stand still, and year by year our endeavours must be continuously increased.

The Society of Arts is the medium of presenting to the public many suggested improvements in arts, manufactures, and commerce, but it has never been anxious to keep

the work entirely to itself. It is always ready to help the formation of new organisations when it is proved that the great field can be better cultivated by the child breaking away from the parent; hence many flourishing societies have grown from the mother Society of Arts.

H.R.H. the late Prince Consort alluded to this characteristic of the Society of Arts as the mother of the societies on an interesting occasion when a deputation of the Society presented him with a congratulatory address on the marriage of the Princess Royal (afterwards the Empress Frederick). He said:—

"That this sympathy should be re-echoed by your Society, which during fourteen years has commanded my best wishes and any feeble assistance which I could render it, must be most gratifying to me. Gentlemen, these fourteen years which have seen my daughter grown up from an infant to become a wedded wife, transferred to a high sphere of usefulness in a foreign land, to which our most tender affection must still follow her—have also seen children of yours—I mean the many plans and schemes for the promotion of art, science, and industries which you have originated—develop themselves and grow up in independent life and power. Some of these have attracted the admiration of the world, whilst you could only follow them at a distance with the fond eye of a parent who finds his highest gratification in the success of his offspring."

The union and co-operation of societies, such as the Society of Arts and the London Guilds, is needed now as much as ever. As the ages run, the mode of commercial warfare changes, and the country which lags behind, retaining methods that are out of date, and refuses to avail itself of the aid which science produces ready to its hands, must surely be distanced in the race. England has always been slow to learn, but as the late Right Hon. W. E. Forster said in my presence and hearing, although it was generally late, it had never been too late.

The Society of Arts in its corporate capacity, and many of its members, notably the late Sir H. Cole, Sir Frederick Bramwell, Sir F. Abel, had a potent influence on the movement for improving technical instruction, which began soon after the passing of Mr. Forster's Elementary Education Act of 1870. As an outgrowth of the controversies at that time, it began to dawn upon the minds of manufacturers and merchants that this country was a long way behind the Continent in scientific education, as bearing upon productive industry and its underlying problems. This could have hardly been otherwise as, owing to the deficiencies of elementary and no less of secondary education, the foundation on which to build a system of technical instruction was wanting. In the days of manual industry, reliance had been naturally placed upon the Apprenticeship system for the education of youth in the Arts and Crafts; but this system had become insufficient and inadequate in almost all industries owing to their transformation from manual to mechanical methods as a consequence of the growing introduction of machinery and the great subdivision of labour which followed in its train.

Then came the discovery that we were in danger of being defeated in the industrial competition by the increasingly superior productions of Continental countries, which had already adopted the principle and practice of technical education. It was discovered and realised that the Mechanics' Institutes, founded by Lord Brougham and his contemporaries to further industrial instruction, had failed owing to the backward state of elementary education and the miserable methods of scientific teaching then in vogue. The textile trades were—and are—the most important of our manufacturing industries, and the want of technical and artistic instruction was strongly felt in Yorkshire and Lancashire. The silk trade was rapidly dwindling away as a result of the Cobden Treaty with France. The cotton trade indeed had the complete monopoly of foreign markets, but the infantile efforts of continental manufacturers aided by protective tariffs, were beginning to be felt.

The movement for technical education then started in the country naturally required financial support to achieve its end, and covetous eyes came to be cast upon the revenues of the London Livery Companies, which it was alleged had been diverted from their original purpose of trade protection and advancement. The Clothworkers' Company had already recognised and seized its opportunity by taking a leading part in the foundation of the Yorkshire College of Science, at Leeds, of which a weaving school formed an important department. The Company also made other large grants towards the foundation of technical schools at Bradford and at Huddersfield, and they also stimulated and encouraged the foundation of minor schools in other centres of the woollen cloth industry. In 1875 Sir Henry Trueman Wood, who was at the time Assistant Secretary of the Society of Arts, and Sir John Donnelly, afterwards Chair-

man of the Council, contributed valuable Reports to the Committee of the London Livery Companies on the best means of furthering the cause of Technical Education when they were considering the question. The scheme and constitution ultimately adopted by the City and Guilds of London Institute for the Advancement of Technical Education was largely based on these Reports. Soon afterwards, in 1876, the City and Guilds of London Institute was formally constituted, representing a confederation of Guilds able and willing to devote a proportion of their means towards the promotion of technical education irrespective of particular industries, and I had the privilege of taking a primary part in the foundation of that institute as one of its honorary secretaries. The Institute has gone on expanding and increasing its influence ever since, more especially as regards the development of the Technological Examinations already referred to. The growth of the technical education movement soon became so great and remarkable that the State as well as local authorities everywhere have had to recognise its paramount importance, and to devote large funds derived from imperial and local sources towards its development. The livery companies of London have by these and other means, individually and collectively, done much towards advancing technical education in the trades cognate to those in connection with which they received their original charters of Incorporation long centuries ago, and the widely-reaching influence of the Technological Examinations of the City and Guilds Institute, extends even to the Colonies and India. The Livery Companies, in alliance with the Society of Arts, have indeed been pioneers in the matter of technical and commercial education, although by reason of recent Acts of Parliament, large funds are now applicable towards these purposes, besides which the limited resources of the companies—often strangely magnified in the public imagination—have become of comparatively less importance. If, however, the Companies mix brains with their money, and are swift to recognise and appreciate the new developments and potentialities of science in relation to industry, they will do as much—and more—in the future for the industries of the country as their ancestors were enabled to do in the palmiest days of their early history. England goes straight on the right path when really convinced, but we have to see that she is convinced before it is too late, as Mr. Forster said. All who know that this is so, must strive without ceasing. It is only by the union of those agencies competent to influence the country that the great things we still hope for will be accomplished, and that the Society of Arts will continue to contribute its quota of "light and leading" towards the advancement of "arts, manufactures and commerce." I am well assured it will not lack allies in its beneficent work.

This is an industrial era, and to succeed under the conditions in which modern industry has to be carried on a nation must be educated with a primary regard to those conditions. For England this is a question of life or death. The battle of Armageddon—about which we were so much exercised in the days of the now almost forgotten Dr. Cumming—will be an industrial battle, a battle of the nations *à outrance* as the French say. We shall have to realise more and more that "Life without industry is guilt—industry without knowledge is brutality."

Technical education is not enough. A man needs knowledge not only as a means of livelihood but as a means of life. The best sermons I ever read (and I have read many in my time) are lay sermons by the late Professor Huxley, and in this connection I will quote the following wise words:—"The politicians tell us you must educate the masses because they are our masters. The clergy join in the cry for education, for they affirm that the people are drifting away from church and chapel into the broadest infidelity. The manufacturers and the capitalists swell the chorus lustily, they declare that ignorance makes bad workmen, that England will soon be unable to turn out cotton goods or steam engines cheaper than other people, and then Ichabod! Ichabod! the glory will be departed from us. And a few voices are lifted up in favour of the doctrine that the masses should be educated because they are men and women with unlimited capacities of being, doing, and suffering; and that it is as true now as ever it was that 'the people perish for the lack of knowledge.'"

There is a book which I think should be read by everybody throughout the land, Seeley's "Expansion of England." That is a book which sets us thinking on problems which nearly concern our position as a commercial and manufacturing people, who have to live mainly by means of manufacturing raw materials imported from outside sources of supply. We can draw valuable deductions from the events of the past to guide us in

unravelling the complicated problems of the present, for "often do the spirits of great events stride on before the events, and in to-day already walks to-morrow."

History, it has been truly said, is philosophy teaching by example--the rise, development, and mutual influence and interdependence of States—the causes which promote their prosperity or bring about their decay—and these considerations, I say, have a very practical bearing on problems which are confronting us to-day. The dangers which lie ahead of us as regards our national prosperity spring mainly, I think, from two quarters; the new mpatience of the teachings of political economy, and the disinclination of our masters in the constituences to study the bearing and influence of Foreign and Colonial affairs on our material interests at home. The great enfranchised democracy will never feel a real interest in foreign affairs until they understand, as I think they can be made to understand, that this is a "Saturday night"-wages question. Constantinople, Egypt, and India, will soon become interesting enough if we can realise that the smoke from Lancashire, Yorkshire, and Staffordshire chimneys depends largely on a prudent and patriotic conduct of our foreign and colonial relations, which in the interest of all of us, I would gladly see removed from the domain of party politics. Already we see indications of this consummation so devoutly to be wished, and I am certain the more the philosophical study of history is encouraged the better hope shall we have of securing a wise, and at the same time truly patriotic and consistent, treatment of our foreign and colonial policies.

The congeries of isolated Technical Institutions at South Kensington include the Central Technical College of the City Guilds and the Royal College of Science. There seems now to be a fair prospect of "crowning the edifice" of Technical Education, which has, in our English way, been laboriously growing up without much coherence or system. It is proposed to create a new Institution at South Kensington for the teaching of science and technology, where the very highest courses of specialised instruction shall be given, with facilities for the most advanced training and research in the various branches of science as applied or applicable to the arts and industries of the Empire. This can be done by placing the now existing institutions, together with other buildings in course of construction at South Kensington, under some common form of government, and it will be necessary to combine the work of the Royal College of Science (including the School of Mines) and of the Central Technical College as parts of one organised whole.

The Government have, it is understood, agreed to co-operate in this scheme to the fullest extent, and so have the governing authorities of the Central Technical College of the City Guilds, with some minor reservations necessary to preserve their modified autonomy, as well as their own personal identity and continuity. In so doing the City Guilds will again have shewn their willingness to subordinate their own legitimate functions and authority connected with Technical Education to national requirements and exigencies, and they will doubtless have secured to themselves a great influence and adequate representation on the governing body to be created for the co-ordination of the several institutions in being and in prospect, so as to bring about the fulfilment of the great scheme and ideals placed before the country by Lord Rosebery and Mr. Haldane. The co-operation of the London County Council, hardly less important than that of the Government itself, has also been secured, and it is understood that very large amounts of capital and adequate endowments will become available for the maintenance of the new "Charlottenberg" as it has been rather unhappily called. It may be hoped and expected that the experience of the Society of Arts in connection with Technical Education in the past may be utilised by some representation of their Council being accorded on the governing body of this great new Institution.

I have left myself but little space to deal with any other department of the Society's work, even had I thought it desirable or even possible to include such a reference, but I should like to allude to that very valuable series of publications—the Cantor Lectures. It is now a little over 40 years since the Council of the Society, in 1863, decided to devote Dr. Cantor's bequest to providing courses of lectures by eminent men on "International Commerce, Chemistry applied to Manufactures, and Industrial Art." The scope thus defined for these lectures has, as you know, very much broadened, and there is hardly any application of any branch of Science or of Art to any branch of Industry which has not been illustrated and illuminated in one or more courses of the Cantor Lectures. Looking down the long list of lecturers, we find that the intentions of the Council in 1863 have indeed

been fulfilled as regards the character of the lecturers, for the names which it contains are of very high repute. Many of the lectures were given by men who had already attained eminence. Many others, I am glad to think, were given by younger and rising men who have since attained eminence, and have been assisted in that attainment by their work for the Society. Some of the courses have been elaborated into standard works, others are still valuable text-books for the subject with which they deal. The whole series forms what may be regarded as an encyclopedia of Science and Art as applied to Industry.

Another branch of the Society of Arts which I do not like to pass over entirely in silence is the work done by occasional committees, and I am induced to make special reference to this work on the present occasion because within the last few days has been published a very valuable Report on Leather for Bookbinding, the work of a Committee appointed by the Council of the Society. It is owing to the liberal aid afforded by the Leathersellers' Company—and here again is an illustration of an alliance between the Society and an ancient City Guild—that the Society has been able to issue the Report in the complete and finely illustrated form which it now possesses. The original Report, of which the present issue is an enlarged and elaborated edition, has already, I am glad to know, had very great practical effect on the binding of books, since I understand that it has become largely the practice of librarians and owners of books to demand leather for their bindings of the character recommended by the Society's Report, instead of the perishable material which it was the object of that Report to replace. The Council and the Society are specially indebted to the members of the able Committee which is responsible for the Report. So many of them devoted time and trouble to the work that I hesitate to mention names, though I should much like to do so, but I am sure I shall have have the approval of the Committee if I say that the Society owes a debt of gratitude to the Chairman of the Committee, Lord Cobham, for the keen interest he has evinced in the subject, and the help he has rendered in the preparation of the Report.

Before I sit down, I should like to record a word of regret that it has not been found possible to consolidate and unite the forces and resources of the Society of Arts with those of the London Institution. The aims and objects of both Institutions are very cognate, and I think it is a great pity that some means cannot be found of creating citywards a new and larger organisation for dealing with the problems of the future as regards "Science, Arts, Manufactures, and Commerce," instead of allowing energies to be dissipated which would be multiplied and intensified by cohesion.

I have now done. I have talked perhaps a little too much about the London Guilds, but their honour, reputation, and usefulness is a subject very near to my heart. This Address has dealt with matters a little outside the topics of what has been usually considered as suitable for an Opening Address of the Society of Arts. I do not profess, however, to be a man of Science, and I hope that I may be pardoned for having drifted into channels not usually navigated here.

After delivering the Address the Chairman presented the Society's medals which were awarded for papers read during last Session.

At the Ordinary Meetings :—

To Mr. Charles Denton Abel, for his paper on "The Patent Laws."

To Captain Lionel James, for his paper on "Wireless Telegraphy and War Correspondence."

To the Hon. Robert P. Porter, for his paper on "London Electric Railways."

To Mr. R. Child Bayley, for his paper on "Time Development in Photography, and Mechanical Methods of Carrying it Out."

To Baron Kencho Suyematsu, B.A., LL.M., for his paper on "Ethics of Japan."

To Dr. E. H. Hankin, for his paper on "Methods of Design in Mohammedan Art."

To the Right Hon. Sir Herbert Maxwell, Bart., M.P., for his paper on "British Woodlands."

To Mr. George Torrance Milne, F.R.G.S., for his paper on "The Industrial Resources of the State of Matto Grosso, Brazil."

To Viscount Mountmorres, for his paper on "The Native Races of the Unknown Heart of Central Africa."

In the Indian Section :—

To Mr. T. C. Hodson (late I.C.S.), for his paper on "Manipur and its Tribes."

To Sir J. George Scott, K.C.I.E. ("Shway Yoe"), Superintendent and Political Officer, Southern Shan States, for his paper on "The Prospects of the Shan States."

To Dr. Charles Creighton, M.D., for his paper on "Plague in India."

In the Colonial Section :—

To Mr. BYRON BRENAN, C.M.G., for his paper on "British Commercial Prospects in the Far East."

To Mr. C. F. JUST, Canadian Government Service in London, for his paper on "The Manufactures of Greater Britain.—I. Canada."

To the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia, for his paper on "The Manufactures of Greater Britain.—II. Australasia."

In the Applied Art Section :—

To Mr. THOMAS GRAHAM JACKSON, R.A., for his paper on "Street Architecture."

To Mr. F. BLIGH BOND, F.R.I.B.A., for his paper on "West Country Screens and Rood Lofts."

To Mr. ARTHUR LEE, J.P., for his paper on "The British Canals Problem."

Lord KELVIN, O.M., G.C.V.O., F.R.S., in proposing a hearty vote of thanks to Sir Owen Roberts for his admirable address, said that Sir Owen had traced in an interesting manner the history and progress of Arts, Manufactures, and Commerce from the earliest age down to the present day, and had emphasised the alliance which he (Sir Owen) had done so much to promote between the City Guilds and the grand old Livery Companies of London, some of which were six hundred or more years old when the Society of Arts came into existence. It was largely due to the efforts of Sir Owen and his brother workers that these companies had done so much in modern times to promote the objects for which the Society of Arts existed, instead of being idle and useless, and cumbering the ground as such ancient institutions might have done. It was impossible to conceive any form of company or inheritance of property that would have done more to promote the original objects of the Guilds when they came into existence 600 years ago than the modern beneficent working of the present great City companies.

Sir JOHN WOLFE-BARRY, K.C.B., F.R.S., before seconding the resolution, expressed the pleasure and gratitude that all those present experienced at seeing Lord Kelvin amongst them again restored by a good Providence to health and strength, and once more resuming the post which he had occupied so long in guiding the scientific mind of the country in all manner of useful and beneficent work. Sir Owen Roberts had concluded his eloquent and suggestive address by an apology for tracing the good work of the City companies, but no such apology was needed, because those who belonged to the Society of Arts recognised to the full the enormous work which had been done by the City and Guilds of London during recent years. If it had not been for them much of the technical education of the country would have been lagging behind, instead of being, as he thought, in a very much more satisfactory condition than in former times, and it must be a great pleasure and gratification to those who had borne the burden and heat of the day, such as the Chairman, who was one of the first to initiate the new departure of the City and Guilds of London, to find that their efforts had produced such good results. The great "crowning of the edifice" which they all looked forward to at South Kensington must ever be associated with the late Prince Consort, a former President of the Society, who was perhaps the first influential man in the country to direct the attention of the people to the backward state of technical education, and to whom everyone who had studied the question recognised that an enormous debt of gratitude was due. It was a great honour and satisfaction to the Society to know that the Prince Consort was associated with it for so long, and that he expressed the vigour of his mind, and his influence upon the work of technical education through the organisation of the Society of Arts. To those who were on the Council of the Society, it was a great pleasure to sit under the chairmanship of Sir Owen Roberts, because they looked back with great gratitude to the many works he had done for the good of the country, and looked forward to the equally good work which they all hoped he would be able to perform during his term of office. It was a position of trust, the responsibility of which Sir Owen keenly felt, and the members looked forward to great results in the future in his firm, judicious, and experienced guidance in the chair of the Society.

The resolution having been carried,

The CHAIRMAN, after thanking Lord Kelvin and Sir John Wolfe-Barry for their kind remarks, and the members for the cordial manner in which those remarks had been received, said he ought perhaps to say that, in the earlier portion of his address especially, he had utilised or adopted a good deal of matter from various sources, including a most able digest of the Report on the Livery Companies Commission of 1884, which appeared soon afterwards in that invaluable publication, "Whittaker's Almanack."

SIBERIA.

Siberian Railway Development.—The announcement that the St. Petersburg-Vologda-Viatka Railway will be opened for regular passenger and goods traffic over its whole centre on October 1st (14th), is in near accord with the official intimation of April

The distance from Kourgan to Viatka by this new rail route is 800 miles, involving new rail construction to the extent of 637 miles, at an estimated cost of 75,200,000 roubles. The distance from Viatka to St. Petersburg is 786 miles, and the cost 82,150,000 roubles. This line brings the capital into direct communication with Siberia instead of, as hitherto, *viâ* Moscow alone, and thus gives Siberia another prominent import and export route materially affecting existing traffic conditions and communications. There are numerous other railway projects—among them a continuation line from Tiumen and Tobolsk, which would still further facilitate the connection between the great river communications and the railway system, and more especially forward the export of grain *viâ* Archangel at present hindered, so far as river traffic is concerned, by the shallowness of the Tura—the realisation of which is but a question of the future. Now that the war is over, it may be expected that the development of Siberia will again grow apace, and although the general conditions of the country, the prevailing level of culture, the limited demands and purchasing capacity of its inhabitants, and exorbitant Customs duties, limit the consumption of foreign made articles that are not indispensable, the market is a growing one, and the British manufacturer ought to have a fair share of it.

British Goods in Siberia.—He has not got it at present. Siberia now comes second, or next to Denmark, in value and quality as the source of supply of the British demand for butter; but although Great Britain is the largest purchaser of the manufactured article, she has no share in supplying the dairy accessories in local demand. And it is much the same with other imports. The sale of modern agricultural machinery is extending far and wide in largely increasing quantities in almost every part of Western Siberia. The total import of agricultural machinery from European Russia and abroad to Western Siberia and the bordering Steppe regions, rose from 864,000 roubles in 1898 to 6,000,000 in 1903; but little of it comes from the United Kingdom. Competition with the United States in mowers, rakes, and harvesters seems hopeless. British ploughs are unknown, sickles are mostly Austrian or Russian. In dredgers and mining machinery this country is more to the front, but at present general machinery and mechanical appliances are not required on any large scale. What there is of it mostly comes from Germany. British cutlery is seen nowhere, nor British guns, and British cycles are seldom seen. The general complaint seems to be that British articles are too dear. Cheapness is an attribute indispensable in Siberia. The British commercial travellers do not work the country as Germans and Americans do, and British firms will not give the long credit—often extending to one or two years—which seems as necessary to trade with Siberia as cheapness. At present it is not a very inviting or a large market, but railway development will work wonders there as elsewhere.

HOME INDUSTRIES.

The Consumption of Tobacco.—A leading American trade paper, referring to tobacco prices and the foreign outlook, says that a steady growing home consumption during the last four years has increased prices for tobacco, and benefited both the grower and manufacturer, while diminishing exports, and affecting the merchant injuriously. "The universal demand has increased supplies, and while no single country has thus far threatened to become a rival to the United States in the production of tobacco, yet the aggregate leaf grown in other lands is thrice our own output, and is increasing more rapidly than ours." The imports of tobacco into the United Kingdom hardly sustain this view. Taking the nine months of this year ended September 30, and comparing them with the similar period of last year, it will be found that whilst beer, spirits, wine, and tea show decreases, the imports of unmanufactured tobacco have increased from 61,489,281 lbs. to 63,707,308 lbs., the manufactured article having fallen slightly from 1,739,274 lbs. to 1,636,746 lbs. Taking American imports of tobacco for the nine months to September 30 of the three years 1903-5, we have the following:—

	1903.	1904.	1905.
	lbs.	lbs.	lbs.
Unmanufactured, stemmed	34,598,582	25,109,883	7,636,475
,, unstemmed	16,387,450	35,612,572	42,292,350
Cigars	1,051,112	1,004,043	1,078,327
Cavendish & Negro Head.	513,880	705,044	624,269
Cigarettes	150,686	14,711	21,152

The most striking figures are those relating to cigarettes, which show an enormous decrease in the import, not made up by larger imports from other countries. On the contrary, the imports from countries other than America have fallen, taking the same period, from 310,562 lbs. in 1903, to 248,794 lbs. in 1905.

The Price of Rubber.—The price of rubber continues to go up. Last week, best Para was sold at 5s., and Plantation Straits (sheet), 6s. 1¼d. Taking the average of all sorts, the price has advanced from £13 11s. 3d. per cwt. in 1903, to £16 8s. 9d. in 1905. It was never at so high a level. In 1861, fine Para could be bought for 1s. 6d. per lb., in 1882 it touched 4s. 11d., when prices fell away again, and in July, 1902, there were sales at 3s. per lb. The import of rubber into the United Kingdom shows steady increase from 1886, when the quantity imported was 194,748 cwts., until 1903, when it reached 486,105 cwts., valued at £6,742,666. The increase continues, as will be seen from the following figures, which give the imports for the nine months ended September 30th, 1903-5:—1903, 350,529 cwts., value £4,782,088; 1904, 372,518 cwts., value £5,686,128; 1905, 414,877 cwts., value £7,026,857. In the nine months of 1905 to September 30th, the value of the

rubber imports was more than for the whole of 1903, and more than twice as much as the value of the importation for the whole of the year 1893.

The Sources of Rubber Supply.—There must be ample rubber in the forests of the world to meet the world's demand if it can be got at, and the trees are treated properly, but the risk of depending upon what may be called wild rubber is exemplified by the experience of Lagos. Ten years ago that colony exported rubber to a value of over a quarter of a million sterling per annum; now it is illegal to export it at all. The tapping of the few trees which survived the onslaught of the collectors during the rubber fever in 1895-8, says the Acting Colonial Secretary, in his report upon Lagos, just issued (Cd. 2684), was prohibited in 1899. Notwithstanding the prohibition, the rubber exports from Lagos were in 1903 £15,583, and in 1904 £22,961, which indicate how difficult it is to supervise matters at the source of supply. But owing to the reckless treatment of the trees it must be many years before exports of rubber from Lagos can again reach the figures of ten years ago. When tapping is again legalised, it is hoped by means of licenses and other methods to keep a better check upon over bleeding, but it is impossible to keep a proper watch upon the whole of an African forest. The cultivation of rubber has already been successfully accomplished in India, the Malay Peninsula, and elsewhere, and as time passes, and the searchers have to go further inland for the rubber, it may be expected that rubber plantations will supply a large portion of the world's demand, a demand constantly growing; but this means higher prices for rubber. Meantime it may be noted that the French colony of the Ivory Coast sent to Liverpool last year rubber of the value of £207,520, the value of the whole exports of the colony being only £411,389.

The Cotton Supply.—Although the extent of the raw cotton supply for the season ending August, 1906, remains doubtful, probabilities point to an adequate supply. The American crop of last season was 13,556,841 bales, the average crops for the previous five years being only 10,300,000. The present crop will be nothing like that of last year, but it is expected to be nearer 11,000,000 bales than 10,000,000, if the weather is fine. From all other quarters from which our cotton supplies come the reports are favourable. The Egyptian cotton crop is expected to be a record one. The Egyptian cotton crop of 1904 was a partial failure. The area planted with cotton in Lower Egypt was at least as great as in 1903, whilst in Middle Egypt—partly owing to the conversion of the basin system into a system of perennial navigation, and partly to the rise in price—there was a great extension of cotton cultivation. The total area planted with cotton throughout the country rose from 1,275,677 acres in 1902 to 1,332,500 acres in 1903, and to 1,346,708 acres in 1904. In spite of this great increase of area the crop fell short, and the quality was much below the average, unfavourable results partly due to climatic causes, and also to the destruction caused by the cotton-worm and the boll-worm. This year the reports are much more favourable. In India last year the outturn showed an increase of 11 per cent. on the previous year, and the reports of the present season are very favourable. Lancashire uses scarcely any East Indian cotton, but it is expected that we shall have 300,000 bales more this year than last year. Indian cotton is of short staple, and its destination will be gathered from the following figures (cwt. 000 omitted) :—

	1900-1.	1902-3.	1904-5.
Japan	634	1,722	1,951
Germany	656	1,122	1,025
Belgium	599	799	668
Italy	421	647	627
Austria-Hungary	381	569	456
United Kingdom	381	372	347

Good accounts have been received of the Brazilian crop, and a larger supply is expected this season than last year, when the imports of raw cotton into the United Kingdom from Brazil were only 186,690 cwts. There was never a time when the demand for raw cotton was so great. Not only are all the mills in Great Britain working at full stretch, Continental mills and American factories are also very active.

Cotton Mill Buildings in Lancashire.—Nothing in the industrial history of the country during the last eighteen months has been more astonishing than the activity in the erection and equipment of cotton mills in Lancashire. It is estimated that the total new capital involved since the period of depression is close upon £6,000,000 and must soon exceed it. Nor has the building mania exhausted itself. Several new schemes are announced for both spinning and weaving in the Manchester, Oldham and Rochdale districts. A noteworthy feature of several of these new mills is the substitution of electricity for the fly wheels, belting, and long lines of shafting for conveying suction from the engine to the machines. Last year the Board of Trade prepared an estimate of the total number of spindles working in the world. It may be interesting to reproduce it.

Total number of spindles in the world	110,600,000
Ditto in 1900	104,200,000
Ditto in 1890	88,700,000

Made up as follows (including recent additions) :—

United Kingdom	47,900,000 spindles
Europe	33,000,000 ,,
United States	22,200,000 ,,
Other Countries	7,500,000 ,,

The number of spindles in 1870 were—

United Kingdom	37,700,000 spindles
Europe	13,000,000 ,,
United States	7,100,000 ,,

The increase in this country of spindles during the last eighteen months has been enormous. Taking the average cost at £1 per spindle, the £6,000,000 named above would mean 6,000,000 new spindles. The percentage of increase on the Continent and in the United States, although large, has been less.

The Sources of Raw Cotton Supply.—Unfortunately our reliance upon the United States for our supply of raw cotton shows little sign of diminishing, as will be seen from the following figures:—

	1900.	1902.	1904.
United States ... cwts.	12,190,169	12,177,136	13,310,446
Egypt............... ,,	2,789,722	3,168,697	2,899,235
India .... ,,	311,841	289,923	846,471
Brazil..... .... lbs.	3,267,494	5,291,180	3,767,599

The British Cotton Growing Association is doing an excellent work in encouraging the growth of cotton in our tropical colonies, but the difficulties in the way of extensive cultivation are many, and at best it must be many years before the supplies of cotton from within the Empire lessen to any material extent the present dependence upon the United States.

NOTES ON BOOKS.

THE PLENUM OR PROGRESSIVE SYSTEM OF HEATING AND VENTILATION. By Harold Griffiths. Simpkin, Marshall, Hamilton, Kent and Co.

Of late years science has made great strides in the construction and equipment of buildings, and more especially in the direction of sanitation. Health has become a prominent factor in the requirements of the public, but, strangely enough, heating and ventilation have lagged behind. To-day, as a hundred years ago, they are effected in most of our buildings by means of fires and windows. Improvements have been made in grates and stoves, and inventions in the shape of ventilators are numerous, and some of them excellent, but they leave a good deal to be desired. Science and invention have produced more effectual modes of warming and ventilation, but they are not widely known, and so are not generally appreciated and adopted. In writing a short practical account of the principles of plenum ventilation, Mr. Griffiths has attempted to bridge the gap between the expert knowledge and no knowledge at all which largely exists in connection with this important branch of sanitation. By plenum (or the opposite of vacuum), is meant the system of constantly pressing or forcing air into a building, and thereby changing the whole of the atmosphere continually, thoroughly, and regularly. It is mechanical ventilation as opposed to natural, and how it is brought about, why it is better than natural, the comparative cost, and much else appertaining to his subject is dealt with in a lucid and interesting way by Mr. Griffiths who is, himself, a highly qualified expert.

PRACTICAL GILDING, BRONZING, AND LACQUERING. By Frederick Scott. The Trade Papers Publishing Company.

This is the first of a series of a practical books of a technical character, published from the *Decorator* office, and written by the lecturer, on "Decoration," to the City and Guilds of London Institute, and the London County Council. Gilding, bronzing, and lacquering are used in many trades and crafts, and hitherto, Mr. Scott-Mitchell says, there has been no work, issued at a popular price, dealing comprehensively with these subjects. The present volume deals with all branches of leaf and powder gilding, silvering, bronzing, and lacquering, but the arts of electro-plating and chemical deposit gilding, which form in every way a separate and distinct business, requiring a totally different plant, tools, and materials, are not dealt with. The term, "gilding," as used in this book, covers the application of all metal leaf or powders, whether of gold, silver, bronze, or baser metals, by means of any adhesive vehicle, or mordant, to fix the metal permanently upon the surface it is intended to embellish. The book is practical and comprehensive, and published at a price within the reach of all craftsmen.

PRACTICAL PLUMBER'S WORK. By Paul N. Hasluck. Cassell and Co., Limited.

This is largely a reprint of information contributed by experienced craftsmen to the *Building World*, to some extent re-arranged and re-written. The duties of the plumber may be described under three heads: —(*a*) He has to keep water out of houses—that is roof work; (*b*) he has to get water into houses, and store and distribute it where required for use; (*c*) he has to get it out of houses when it has served its purpose. In some places he is also painter, glazier, paper-layer, gas fitter, hot-water fitter, bell hanger, coppersmith, tinsmith, locksmith. Mr. Hasluck confines himself in this volume to working in lead, and has produced a useful manual of its kind.

SUPPLEMENT TO THE ILLUSTRATED CATALOGUE of the Publications of Messrs. Henry Graves and Co., from 1902 to October 1905. London.

This catalogue contains a list of the publications of Messrs. Graves during the period named, which is illustrated by reduced reproductions of the plates catalogued, these representing engravings after Vandyck, Reynolds, Gainsborough, Romney, Hoppner, Meissonnier, and many more modern painters. The publishers claim to be the first English house to price their prints in four different coins—guineas, dollars, francs, and marks.

LEATHER FOR LIBRARIES. By E. Wyndham Hulme, J. Gordon Parker, E. Seymour-Jones, Cyril Davenport, and F. J. Williamson. London. The Library Supply Company.

This volume contains several essays on points connected with the important question of the life

of "Leather Bindings in our Libraries," published by the Souud Leather Committee of the Library Association. This is a subject already dealt with by a Committee of the Society of Arts, in a Report on "Causes of Premature Decay of Leather for Bookbinding," an illustrated edition of which has just been published. Mr. Hulme deals with the History of Sumach Tanning in England; Degradation of the Manufacture of Leather, and History of the Reform Movement; Dr. Gordon Parker on the Causes of Decay in Bookbinding Leather; Mr. A. Seymour-Jones on Provenance, Characteristics and Values of Modern Bookbinding and Leathers; Mr. Cyril Davenport on the repairing and binding of Books for Public Libraries, and Mr. F. J. Williamson on Specifications for the fittings of a small Building.

Garden City and Agriculture: How to Solve the Problem of Rural Depopulation. By Thomas Adams. With an Introductory Address by H. Rider Haggard. London: Simpkin, Marshall, Hamilton, Kent and Co.

The author enters into the whole question of the remedial measures necessary for the successful cure of the great evils of overcrowding and depopulation, and he deals with it from the point of view of the garden city movement. He says respecting this, that "if the reader should doubt the stability of this movement, or its power to help in solving the problems of overcrowding and depopulation, let him or her try to realise the phenomenal rapidity with which it has caught on with the public. That a scheme of such magnitude should have practically become a realised fact five short years after the propaganda was first instituted, proves that the time is really ripe for the creation of 'garden cities.'"

GENERAL NOTES.

Long Credit.—In this country long credit has ceased to be the rule, but in Wurtemburg it seems to be longer than ever. In his report on the trade of that State just issued (No. 3511, Annual Series), Mr. Consul H. Gastrell says that the manufacturers and wholesale dealers complain of the unduly prolonged credits demanded by retail dealers for goods delivered. Bills at long dates of 12 and 18 months are not unusual in some trades, and are often not met in full at maturity, and have again to be prolonged in part. In fact in many trades a marked feature is that credit giving increases in proportion as the price of the goods decreases. The Stuttgart book trade in 1904 was active, and the export reached the record figure of 4,820 tons, as against 4,710 tons in 1903. Stuttgart still holds a foremost position in this trade.

Madagascar.—Whatever other advantages the French occupation of Madagascar has brought to the natives, cheapness does not seem to be one of them. The consumption dues, and the taxes which have replaced the "prestation," or forced labour, has sent up the price of imports. For instance, the consumption dues on French cotton tissues, which was at first 3 per cent. *ad valorem*, was raised to 5 per cent., and is now 8 per cent., so that a bale of cotton goods which the Malagasy could formally buy at say £12, now costs £16. A good deal was heard earlier in the year of gold discoveries in the island, but the figures given by Mr. Consul Sauzier in his annual report (No. 3509, Annual Series), do not show very rapid development of the gold-mining industry. In 1900 the value of the gold exports was £143,516, in 1904 £307,718. Reefs have been found, says the Consul, in different parts of Madagascar, but have not been worked as proper machinery and plant have not reached the island as yet.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 20...United Service Institution, Whitehall, S.W., 3 p.m. Captain H. H. Paynter, "The Use of the Motor Car in Warfare."

Sociological, School of Economics, Clare Market, W.C., 8 p.m. Mr. A. E. Crawley, "The Origin and Function of Religion."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mrs. Fanny Bulloch Workman, "First Exploration of the Hoh-Lumba and Lobson Glaciers (Himalaya)."

British Architects, 9, Conduct-street, W., 8 p.m. Mr. R. A. Denell, "American Methods of Erecting Buildings."

London Institution, Finsbury-circus, E.C., 5 p.m. Sir William Henry White, "Submarines."

Tuesday, Nov. 21...Cyclists' Touring Club, Metropolitan Section, at the House of the Society of Arts, John-street, Adelphi, W.C., 8 p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Saner's paper, "Waterways in Great Britain."

Pathological, 20, Hanover-square, W., 8½ p.m.

Anthropological, 3 Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. E. T. Cook, "Hollies."

Wednesday, Nov. 22...SOCIETY OF ARTS, John-street, Adelphi, W.C, 8 p.m. Mr. F. Martin-Duncan, "The Cinematograph and its Applications."

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover square W., 8½ p.m.

Thursday, Nov. 23...Tramways and Light Railways Association, at the House of the Society of Arts, John-street, Adelphi, W.C., 8 p.m. Mr. W. L. Green, "Paving of Roadways."

Royal, Burlington-house, W., 4½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Rev. George Henslow, "Geographical Botany Interpreted by Direct Response to the Conditions of Life."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m.

Friday, Nov. 24...Botanic, Inner Circle, Regent's-park, N.W., 4 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

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FRIDAY, NOVEMBER 24, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, NOVEMBER 27, 8 p.m. (Cantor Lecture.) DR. J. A. FLEMING, F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (Lecture I.)

WEDNESDAY, NOVEMBER 29, 8 p.m. (Ordinary Meeting.) SIR WILLIAM H. PREECE, K.C.B., F.R.S., "The British Association in South Africa."

Further details of the Society's meetings will be found at the end of this number.

SOCIETY OF ARTS EXAMINATIONS, 1906.

MEDALS AND PRIZES.

The following new Regulations will come into force at the next Examinations, April, 1906.

No Prize or Medal in any subject will be awarded to anyone who is now, or has acted as, a teacher in that subject; and no teacher at any Institution where an Examination Centre exists will be admitted to examination at that Centre.

No Prize or Medal in any subject will be awarded to any person over the age of 23 years whose profession or occupation is connected with that subject, unless he or she has been a regular attendant at a class for instruction in the subject of examination during the twelve months preceding the date of examination.

The Council of the Society of Arts will be the sole judge in each individual case of the qualifications of the candidate to receive a Prize or a Medal.

REPORT ON LEATHER FOR BOOKBINDING.

The enlarged and illustrated edition of the Report of the Committee on Leather for Bookbinding is now ready. It is published by Messrs. George Bell and Sons, of York-house, Portugal-street, W.C., at the net price of 10s. 6d. Members of the Society requiring a copy can obtain one, at a discount of 25 per cent., by applying direct to the Secretary of the Society.

The whole of the report has been re-cast, and a good deal of it has been re-written. Considerable additions have been made to the portion dealing with the preparation of leathers for bookbinding, and there is an additional appendix dealing with the fading of colour from dyed leathers. There are eleven coloured plates. The frontispiece gives examples of binding in morocco and calf executed during the last fifty years showing the strongest evidence of decay. Of the remaining coloured illustrations eight show the effect of light, gas fumes, moisture, and other destructive agencies upon leather, and two the effects of light upon leather dyed with various dyes. All these illustrations have been reproduced photographically by the three-colour process, and are as near fac-similes as it is possible to obtain of the original examples. The specifications for binding books which formed a part of the original report are now fully illustrated with woodcuts, and there are some further illustrations showing the strengths of leather treated in various manners, &c.

Twelve samples of leather prepared in accordance with the conclusions of the committee's report are given in the cover. These have been kindly supplied by Messrs. J. Meredith-Jones and Sons, Wrexham; Messrs. Edw. and Jas. Richardson, Newcastle-on-Tyne; and Messrs. John Muir and Sons, Beith, N.B.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Friday afternoon, 17th inst. Present: Lewis Foreman Day, F.S.A., in the chair; Alan S. Cole, C.B., Cyril Davenport, F.S.A., Alfred East, A.R.A., W. Gowland, F.S.A., Gerald C. Horsley, Halsey R. Ricardo, W. E. Riley, H. H. Statham, Carmichael Thomas, Hugh Stannus, F.R.I.B.A., Sir Aston Webb, R.A., with Sir Henry Trueman Wood, Secretary of the Society, and Henry B. Wheatley, Secretary of the Section.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 22nd, 1905; PROF. H. E. ARMSTRONG, Ph.D., LL.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Charlesworth, Samuel, Prescott, Uffculme, Cullompton, Devon.
Clarke, Thomas Ernest, The Laurels, 12, Ravenslea-road, Wandsworth-common, S.W.
Diekmann, Hermann, 13, Dulwich-wood-park, S.E.
Glenday, Robert, Assoc.M.Inst.C.E., Government-buildings, Bloemfontein, Orange River Colony, South Africa.
Hebditch, William E., Messrs. Eyre and Spottiswoode, East Harding-street, Fetter-lane, E.C.
Hooper, William Harcourt, 5, Hammersmith-terrace, W.
ngram, Herbert P., 26, Rowlandson-terrace, Sunderland.

The paper read was—

THE CINEMATOGRAPH AND ITS APPLICATIONS.

By F. MARTIN DUNCAN.

In the space of time at my disposal to-night, it is not my intention to dwell upon the past history of the cinematograph, of its origin in he thaumatrope, which consisted of a circular ece of card, having painted on one side a rd, and upon the other an empty bird-cage; or of its gradual development through thaumatrope, Faraday's wheel, and zoëtrope, or wheel of life, but to give a practical demonstration with the aid of the latest and most improved apparatus, showing to what perfection it has reached; and to demonstrate its successful application to Science and Education.

The history of cinematography could never have been written were it not for the physiological phenomenon of persistence of vision, and it is in the earliest apparatus devised to demonstrate this phenomenon that we find the germ of the modern motion picture machine. In the Bodleian Library at Oxford, is one of the only two copies known to exist of Ptolemy's "Optics," a work written about the year 130 A.D. In this rare and ancient work, the author states that if a sector of a disc be coloured, the whole will appear of that colour when rapidly revolved; and if the sector should be variously coloured at different distances from the centre, the disc will appear ringed when revolved. In that statement we have the birth of cinematography.

My first application of photography as a means of keeping a permanent record of investigations in various branches of natural science, began some sixteen or eighteen years ago in helping my father (the late Professor P. Martin Duncan, M.D., F.R.S.) in his works on "The Fossil and Recent Corals and Echinoderms." From that time onwards I have kept a record of all my investigations in natural science, by means of the camera, using in the field various forms of hand and stand cameras, and in the laboratory a special photomicrographic outfit. I have always felt, in my zoological and botanical work, particularly in studying the movements of animals, insects, and plants in relation to special adaptation to environment, that ordinary photography left much to be desired; for although a long series of ordinary photographs will demonstrate various positions of the object under consideration, very frequently the one most characteristic position is not obtained, and the point, therefore, missed. It was this difficulty which led me primarily to consider the advisability of applying cinematography to the study of natural science and to the record of microscopic forms of life.

The importance of teaching through the agency of the eye as well as the ear, is now well established, and every teacher knows that a lecture demonstrated by a graphic series of experiments or pictures, is much more vividly impressed upon the minds of the students, than a simple unillustrated oration.

As a lecturer on and teacher of zoology and botany, I have always felt the great value

of good photographs as illustrations, and I felt that if it were possible to place before my audience "living pictures" of animal, insect, or vegetable forms of life, I should have a very important educational factor in my hands. In the popularity of the cinematograph shows at music halls and theatres I at once realised that there was an important and certain means of educating and enlightening the minds of the masses; practically of amusing and at the same time instructing. Pressure of scientific and literary work put a stop for a period to my attempting to experiment further, and I had to content myself with perfecting my plans and methods at odd moments, so that when the opportunity presented itself I should be able to go ahead. Fortunately, when the time came that my plans were matured, and I was ready to devote my time and attention to the application of cinematography to science and education, I met and joined hands with Mr. Charles Urban (of the Charles Urban Trading Co., Ltd.), the inventor of the bioscope and one of the greatest authorities on cinematography. Mr. Urban has always considered that there is a very great and brilliant future before cinematography, and we have to thank him for the high standard to which these popular exhibitions have reached. He has worked nobly, and with that determination which always brings success, to lift the cinematograph from a mere showman's plaything to an instrument of precision and perfection, and at the same time to raise the tone, quality, and nature of the public exhibitions.

The successful application of cinematography to the microscope was a very difficult task, and many were the unexpected difficulties that had to be combated; however, we have practically overcome them all, and hope during this evening to show you some of the results. So also in the application of cinematography to zoology, the difficulties have been many. To obtain some of the pictures of animal life, I have had to wait and watch day after day, and in some cases for weeks, before I could get the desired expressions or typical movements. Since I joined hands with Mr. Charles Urban our labours have been constant, and we have successfully applied cinematography to natural science research, to microscopy, to electrical and physical phenomena, to medical science, to chemistry, and anthropological work. But although we have covered a good deal of ground, we still see endless possibilities for the application of cinematography.

The camera used for taking these pictures is of special design, consisting of a box-form body enclosing the mechanism which moves the film, and which is of a combined continuous and intermittent principle, assuring absolutely correct registration of the film as it passes through the gate or film trap. The camera also encloses the boxes containing the negative film, which varies in length from 150 to 350 feet; and an adjustable focal plane shutter working directly in front of the film and admitting exposures of varying length being given. As short exposures are the rule, a lens with a working aperture of F. 5·4 is generally employed.

I will now proceed by means of a series of motion pictures, to demonstrate to you some of the applications and possibilities of the cinematograph, describing the pictures as they are thrown upon the screen.

As an example of the value of the cinematograph for anthropological work, I will show you a native Devil dance taken in Borneo. The march of civilisation is so rapidly defacing native customs, that it is of the greatest importance that some means should be adopted for placing them on record, and in this work the cinematograph is the ideal agent, for by its aid we may obtain a truthful and permanent record of these native customs, ceremonies, and dances.

The importance of demonstrating Colonial industries, as an inducement to emigration, cannot be over estimated. And in this work the cinematograph is the best agent possible, reproducing in living pictures the work going on in our Colonies. As examples, I will show the logging industry in the Canadian pine forests, and the salmon fishing industry on the Fraser River. The exhibition of motion pictures showing Colonial industries, the typical scenery of the colony, and the daily life of the colonist will undoubtedly play an important part in the future to attract attention and emigration.

As two examples of the geographical application of the cinematograph, we will watch the rushing waters of the great Falls of Niagara, and wander amid the ruins of the Colosseum at Rome.

As an example of a great home industry I will show you a series of motion pictures illustrating the building of a railway, taken by Mr. Charles Urban.

The first series of pictures illustrating the application of cinematography to science are two which I took to illustrate some of the in-

teresting physical work of Mr. Frederick Hovenden, F.L.S., F.G.S., and which demonstrate the formation of smoke vortices, and the throwing off of minute spheres or molecules from the wick of a spirit lamp upon which the rays of the electric arc are concentrated. For a full description of these interesting phenomena I would refer you to Mr. Hovenden's book, "What is Heat and What is Electricity?" Part V., Div. VIII.

As examples of my successful application of the cinematograph to microscopical investigation, I will now show a series of motion pictures illustrating the circulation and rotation of protoplasm and the movement of the chlorophyll bodies within the cells of the leaf of *Elodea*; the circulation of the blood in the web of the frog's foot, and in the tail of the goldfish.

For the last eighteen months I have devoted much time to the study of ant life, and with the valuable assistance of my wife I have succeeded in obtaining the series of motion pictures, illustrating the life and work of the wood ant, which will now for the first time be shown in public.

As an example of the application of the cinematograph to the study of the movements of microscopic organisms, I show a microbioscope picture of the *Hydra viridis*.

Taking the application of cinematography to the study of zoology, I will show examples of motion pictures of various birds, beasts, and reptiles.

The examples of the various applications of the cinematograph which I show to-night upon the screen will, I trust, have successfully demonstrated the importance and value of cinematography as a factor in scientific investigation and as a popular means of education.

DISCUSSION.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Duncan for his interesting and valuable paper, said the author had given a marvellous demonstration of a very wonderful new instrument, which promised to do a great deal in spreading a knowledge of natural history phenomena, at all events, among the public generally. He had had the pleasure of seeing some of Mr. Duncan's demonstrations before, but had never realised so clearly as that evening how much could be done in the direction suggested. The series of pictures illustrating the rolling of iron rails, and the habits of ant-life, particularly the attack of the ants on the caterpillars, was most remarkable in its life-like accuracy. Comparatively few people had sufficiently good eyes to observe such phenomena, and it was not easy to get the opportunity, so that a demonstration of the nature given by Mr. Duncan helped people to get eyes for things they did not ordinarily see. Schools were being urged by the Board of Education to insist more on the study of geography, but in his opinion not much progress would be made in the teaching of the subject through the ordinary conventional methods. It was not until one travelled about the world that the value of geography was realised, and the cinematograph was beginning to help everyone to travel about the world. The only objection to the cinematograph was that it worked too fast; and he would like to enquire whether there was any probability of it being slowed down. He did not like to see British workmen working at the rate shown in the demonstration, and he did not believe it was even possible for Americans to cut down trees at the rate depicted, although they could cut them down very fast. He presumed the only way of getting over the difficulty was to increase the number of pictures considerably so as to get a smaller difference between consecutive pictures. In according Mr. Duncan a hearty vote of thanks for his valuable demonstration, he was sure all present would wish him further success in the prosecution of what must be a very difficult task.

The resolution of thanks having been carried unanimously,

Mr. DUNCAN, after sincerely thanking the audience for the patience and kindness with which his demonstration had been received, said that the excessive rapidity of the work of the men felling trees was partly due to an insufficiency in the number of pictures covering the action. It must be remembered that the film was very costly. As 150 feet of film passed through the camera in about two minutes, it would be realised that money was being eaten up at a very rapid rate. In taking the pictures of industries particularly, one could not resist asking the men to do their work promptly, as the operation cost about £1 a minute. He must also admit that to enable him to get through the large number of pictures he had shown he had been obliged to show them rather quickly.

The CHAIRMAN inquired whether the pictures, instead of being shown so rapidly, could be shown at the rate at which they were taken, because if that were done the natural effect would be seen.

Mr. DUNCAN replied that the pictures could be projected at the same rate at which they were taken. Provided the negative had been taken at the right speed, and that there was a sufficient number of pictures to accurately cover the motion taking place, it was possible to reproduce them upon the screen, giving the movement at the exact speed at which it was going on.

THE PROGRESS OF CANADA.

The Statistical Year-Book for Canada has just been published, and is a valuable record of the economic development of the Dominion. It opens with a summary which enables the reader to see at a glance the main features and extent of that development. A comparison of the figures of twenty years ago with those of last year—1884 with 1904—shows that the revenue has increased from 31,861,961 dols. to 70,669,817 dols.; the imports from 116,397,043 dols. to 259,211,803 dols.; the exports from 91,406,496 dols. to 213,521,235 dols.; the gross debt from 242,482,416 dols. to 364,962,512 dols., and the net debt from 182,161,851 dols. to 260,867,719 dols.; the number of depositors in post-office banks from 66,682 to 168,572, the miles of railway in operation from 9,576 to 19,431, whilst the population rose from 4,324,510 in 1881, to 5,371,315 in 1901, and shows a much accelerated rate of increase since then.

During this period the trade of the Dominion with the Mother Country has increased enormously, both absolutely, and relatively to that of foreign countries, so far as exports from the Dominion are concerned, but whilst the imports from the United Kingdom have grown slightly, and since 1897 have been helped by a preferential tariff, they have not grown in anything approaching proportion to the growth of imports from foreign countries. The following figures make this plain:—

Year.	Exports of Canada to—			
	Great Britain.	France.	Germany.	United States.
	Dols.	Dols.	Dols.	Dols.
1884	37,410,870	338,162	183,326	34,332,641
1904	110,120,892	1,539,462	1,358,910	66,856,555

In 1884 Great Britain took 46·86 of what Canada had to sell, in 1904 55·50; France in 1884 0·49, in 1904 0·78; Germany in 1884 0·23, in 1904 0·69; the United States in 1884 43·01, in 1904 only 33·70. The record is very different when the imports are taken:—

Year.	Imports of Canada from—			
	Great Britain.	France.	Germany.	United States.
	Dols.	Dols.	Dols.	Dols.
1884	43,418,015	1,769,849	1,975,771	50,492,826
1904	61,777,574	6,206,525	8,175,604	150,826,515

In the twenty years the percentage of her requirements taken by Canada from France has risen from 1·64 to 2·47; from Germany from 1·83 to 3·25; from the United States from 46·67 to 59·98, but from Great Britain it has fallen from 40·14 to 24·57, and this notwithstanding the preferential tariff in favour of Great Britain fixed in 1897 at 25 per cent., and increased in 1900 to $33\frac{1}{3}$ per cent.

The change in the relative positions of Great Britain and the United States as from 40·14 to 24·57, and from 46·67 to 59·98 is not only easily explained —it is natural and inevitable. This is shown by the following list of imports from the United States:— Fruit, 2,113,486 dols.; hides and skins, 2,758,823 dols.; metals, 8,243,305 dols.; oils, 2,689,446 dols.; provisions, 1,863,319 dols.; tobacco, 2,925,742 dols.; vegetables, 520,600 dols.; wood, 2,015,288 dols.; cotton wool, 5,927,226 dols.; breadstuffs, 10,496,791 dols. It is not possible for the United Kingdom to compete with the United States in such articles as these. The position is different with respect to agricultural implements. The total value of the agricultural implements taken by Canada from Great Britain in 1904 was 25,453 dols.; from the United States 2,928,065 dols.; and this notwithstanding the preferential tariff of $33\frac{1}{3}$ in favour of Great Britain. The American manufacturers, accustomed to make for the very similar wants of the United States, and supreme in that department of industry in cheapness and invention, are better able to appreciate the requirements of Canadian settlers, but it might be thought that Great Britain would be able to make a better show.

It is commonly supposed that before very many years have elapsed Canada will be in a position to supply Great Britain with all the corn she requires, but, in view of present results, this seems a sanguine forecast. Taking the provinces of Ontario, Manitoba, New Brunswick, and the North-West Territories, the yield of wheat in 1898 was 63,298,664 bushels, and last year it was not very much more, being 69,029,266 bushels. The percentage proportion of exports to production was 46·5, and as last year our total imports of wheat amounted to 27·72 million of quarters it must be many years before Canada can fulfil the sanguine expectation to which reference has been made even if the present proportion of the wheat exports to the United Kingdom is maintained, an unlikely contingency having regard to the home demand, and the possibility of a very large diversion to the more convenient market of the United States. But if the increase of Canadian exports of wheat to the United Kingdom do not show any remarkable increase the same cannot be said of meats, &c., as the following Table demonstrates:—

	1880.	1900.	1904.
	lbs.	lbs.	lbs.
Bacon	8,604,405	132,156,051	123,943,777
Hams	901,630	2,793,078	3,772,908
Beef..........	333,216	2,548,653	1,828,101
Canned meats ..	—	2,139,207	23,021,794

The returns do not show the increases in the exports to the United Kingdom of eggs, butter, and

cheese, but it has been very great of recent years, and the following are the figures for 1904:—Eggs, 5,679,048 doz.; butter, 22,979,617 lbs.; cheese, 233,299,388 lbs. The export of these articles to other countries was quite insignificent.

Shipbuilding seems to be about the only important industry in Canada that shows retrogression. In 1874, the vessels built and registered in Canada represented a tonnage of 183,010. In 1884 it had fallen to 72,411, in 1894 to 21,243, in 1904 it had recovered a little to 33,192, but that was little more than a sixth of what it was in 1874. The Canadian sea-going ships entered and cleared at Canadian ports shows a slight increase, from 1,634,333 in 1876 to 1,979,803 in 1904, but very much less than the increase of British and foreign craft. The following Table shows the nationalities of vessels doing the Canadian carrying trade by sea, by five year periods, with percentage of each nationality to total tonnage in and out carrying cargo:—

	1884–88.	1899–93.	1904.
British tons...	13,319,072	28,129,046	7,018,654
per cent.	41·9	53·3	58 4
Canadian tons..	7,175,669	6,554,618	1,352,951
per cent	22·6	12·4	11 2
Foreign tons ..	11,272,594	18,047,517	3,656,469
per cent.	35·5	34·3	30·4

Canadian and foreign bottoms show continuous shrinkage, the gain being with the tonnage of the United Kingdom.

Of late years there has been a rapid growth of immigration, chiefly British and American. In 1899 the total was 44,543, in 1902 it had increased to 67,379, and in 1904 to 130,331. The immigration was mainly British and American:—

From	1900.	1903.	1904.
United States ...	8,543	49,473	45,229
English and Welsh ...	4,129	32,510	36,694
Irish ...	343	2,236	3,128
Scotch ...	669	7,046	10,552
Galicians ...	4,992	10,141	7,729
Italians...	—	—	4,445
Hebrews ...	—	—	3,727
Scandinavians ...	714	5,418	3 390
Germans ...	476	1,887	2,966
Roumanians and Findlanders ...	1,310	7,277	2,800

It will be seen that the immigration from the United Kingdom in 1904, was 50,374, the total immigration being 130,331, and from the United States, 45,229. The Irish still prefer the United States, but they are beginning to turn to Canada. Hebrews and Italians do not seem to have gone there in sufficiently large numbers to be included under separate headings until last year; the immigration of Germans was much larger last year than ever before, and the same may be said of French and Belgians, who together accounted for 2,392 in 1904.

The Statistical Year-Book of Canada is a wonderful record of progress admirably presented. If a suggestion may be made it is that where the figures show sharp fluctuations there should be an explanatory note as to the cause.

METROPOLITAN WATER.

The reports of public analysts are seldom seen by the general public, but frequently they contain matter that ought to be of great general interest. The report of Dr. W. Scott Tebb, Public Analyst to Southwark, upon the metropolitan water supply, comes under this head. It may be useful to note its conclusions.

In very early times the water was taken direct from the River Thames, or from brooks or streams in its vicinity. Later, recourse was had to springs in the higher districts, the water being conveyed by earthen or leaden pipes, often of considerable length, to conduits or fountains conveniently situated for distribution. The conduits were artificial hydraulic constructions of some magnitude, and were inspected annually by the Mayor and Corporation. Such names as White Conduit, Lamb's Conduit, and Conduit-street still survive.

By the middle of the sixteenth century further public water supply became necessary, and a Dutchman, Peter Morrys, conceived the idea of forcing water from the Thames by mechanical power. In 1581 the Corporation granted him a lease for 500 years, and a water-wheel was erected under the first arch of London Bridge which was turned by the tide, and worked forcing pumps which impelled water through the streets to the houses. The lease and business were subsequently converted into the London Bridge Waterworks Company, which flourished until the early part of the last century.

In 1606 an Act was obtained by the Corporation to bring a stream of water from springs near Ware, but it was left to Sir Hugh Myddelton to carry the scheme through. In this way arose the New River Company. The water supply again becoming insufficient, five London companies were formed at different times between 1723 and 1822, to obtain water from the Thames in the neighbourhood of London, and these companies continued to supply London with water until, in 1902, they were bought up for the Metropolitan Water Board by arbitration.

Complaints as to the character of the water supplied to the people of London have been continuous, and various inquiries have been instituted by Parliament. In 1825 a Royal Commission was appointed, and reported that "the present state of the supply of water to the metropolis is insufficient." The Commissioners also pointed out that only "insects and suspended impurities" could be separated by filtration; and that "the purity of the water as dependent

upon matters held in a state of solution, cannot be improved by any practicable modification of the process;" also that as the water was largely contaminated by dissolved impurities, "the most perfect system of filtering can effect only a partial purification." For many years after the companies were established Londoners were drinking their own diluted sewage, and it was not until 1848 that the Lambeth Company obtained powers from Parliament to remove the intake to Thames Ditton, beyond the reach of London sewage.

In 1851, another Royal Commission was appointed, which reported that "the entire abandonment of the Thames as a source of supply" was only a question of time, "unless, indeed, artificial means of purification be devised in the meantime, and applied." The report was followed by a Bill, which did not pass, but all the Thames companies thought it prudent to follow the example of the Lambeth Company, and remove their intakes above the risk of contamination by metropolitan sewage.

The next inquiry was entrusted to the Rivers Pollution Commission, which reported in 1866, that "the number of persons whose sewage daily finds its way into the water from which London principally draws its supply, amounts to hundreds of thousands, and that this number is destined greatly to increase, not only by the growth of population, but by the development of the sewerage system." In consequence of this report, a Royal Commission was appointed to inquire into the supply of unpolluted and wholesome water obtainable for large towns by the collection and storage of water in the high grounds of England and Wales, and which of such sources were best fitted for the supply of London. The Commissioners collected a vast amount of valuable evidence, and reported in 1869, recommending Mr. Bateman's Welsh scheme for bringing a supply of water to London. As to the Thames, although they were not satisfied with the purity of its water as compared with water procurable, in sufficient quantity, from other sources, still they were not convinced that this was a conclusive argument for abandoning the supply hitherto used. Soon another River Pollution Commission was sitting, and they reported in 1874, that in times of flood a large proportion of both "suspended and dissolved filth" is conveyed to the intakes of the metropolitan water companies, and that, even in ordinary weather, a considerable proportion of the soluble organic matter of sewage is discharged into the river and its tributaries, and likewise makes its way down to the wells of the water companies. They further expressed their opinion that "there is no hope of this disgusting state of the river being so far remedied as to prevent the admixture of animal and other offensive matters with the filtered Thames water as delivered in the metropolis." They recommended "that the Thames should, as early as possible, be abandoned as a source of water for domestic use." Finally, the Balfour Commission evaded the chemical evidence of pollution, by concentrating their attention on the "bacilli of cholera and typhoid," which they affirmed were held by the water companies filters.

Are cholera and typhoid fever propagated by drinking water? Dr. Tebb is of the opinion that an examination of the cholera history of several of the large towns "suggests that drinking water was at least one of the causes by which this disease was disseminated in epidemic form in 1831-2, 1848-9, 1853-4, and 1866. In neither Manchester nor Glasgow did cholera spread to any considerable extent after the introduction of a pure drinking water supply. As to typhoid, its etiology is still enveloped in doubt, and the nature of the contagion has not yet been determined, but bad water has something to do with it. Dr. Tebb says, "It cannot be too strongly insisted upon that we know nothing of the essential cause of either typhoid or cholera, that the medical profession is as much in the dark now as it was forty years ago, and to suppose, as inferred by the Balfour Commission, that a few thicknesses of sand and gravel in a filter will hold back these diseases is a very dangerous doctrine:" those "few thicknesses of sand and gravel" being all that stands between the people of London and much foul water. With regard to the conclusions to be reached from the various tests of Thames water taken in recent years, Dr. Tebb is of the opinion that "there has been a slight improvement, that is to say the water is not quite so largely polluted as it was thirty-five years ago. The improvement, however, is not a very material one, and certainly not sufficient to warrant any alteration of policy adopted by the earlier analysts with regard to leaving the river as a source of supply." Apart from the chemical analyses, there is, in Dr. Tebb's opinion, "abundant evidence to show that the Thames water is seriously contaminated." The rivers and streams of the water sheds on the upper Thames and Cherwell receive the drainage from many towns, villages, and dwelling-houses and farmyards, and industries, including that from 8,000 to 9,000 water-closets. In consequence a great amount of refuse reaches the river more or less directly, and in times of flood this is intensified. Nor is it safe to assume that because the sewage of a place is cut off from the rivers, and treated by some chemical process, or land irrigation, there is necessarily no pollution. Even allowing for a certain amount of improvement, if regard is had to the increase of population, to the augmentation of pollution from sewage works, and to the increasing number of persons using the river as a pleasure resort, the total nett result, especially in times of flood, is, in Dr. Tebb's opinion, little better than it was fifteen years ago.

Dr. Tebb claims to have shewn—(1) That five out of the seven Commissions, or Committees, of Inquiry which have investigated the quality of Thames water, have condemned the river as a source of domestic supply to the metropolis. (2) That the quality of the water as indicated by the analyses has shown no substantial improvement during the last thirty years. (3) That the river and its tributaries are at the present time extensively polluted by

sewage, sewage effluents, foul house refuse, and other obnoxious matters. (4) That it is doubtful if this excessive pollution can ever be prevented, especially in times of flood, from gaining access to the river. (5) That there is no reason to suppose that the poison of cholera or typhoid can be eliminated from drinking water by any practicable powers of purification such as filtration. Dr. Tebb argues that London ought as soon as possible to abandon the Thames as a source of domestic supply. Other large towns, such as Liverpool, Glasgow, Manchester, Birmingham, have now obtained pure water for their inhabitants, and "it is much to be deplored that our great metropolis should still lag behind in a matter which so vastly concerns the health and happiness of her citizens."

OSTRICH FARMING.

The following is an abstract of a paper read by the Hon. Arthur Douglass before the British Association at Cape Town in August last :—

The domestication and farming of ostriches for the production of feathers was first commenced in 1857. Previous to that no ostrich had ever been bred or reared in a tame state, though a few captured wild birds had been kept in confinement in Zoological Gardens. The idea was universal that the ostrich would not make a nest and sit in confinement, hence the first effort at hatching and rearing was done by incubators, and this was brought to very great perfection, from 90 per cent. upwards of the eggs put into the incubators being hatched, and this method was largely pursued for many years. Previous to 1867 the world's supply of ostrich feathers was obtained by the destruction of the wild birds in Southern and Northern Africa, and this destruction was proceeding at such a pace that, had it not been for the successful domestication of the bird, it would ere this have probably been nearly extinct. Ostrich farming is practically confined to the Cape Colony; it is only to a very limited extent existent in the other colonies of South Africa. Efforts have been made to start it in Egypt, New Zealand, Australia, South America, and California, but with very doubtful success, whilst in the Cape Colony it has been a continuous success from the first. In 1880 the colony's export of ostrich feathers were 163,065 lbs., about one-eighth of which was from wild birds. In 1904 the export was 470,381 lbs., practically the whole of which was from tame birds. The Census of 1891 gave 154,880 tame birds in the colony, whilst the Census of 1904 gave 357,970, so that in the last 13 years the number has more than doubled. This rapid increase has been mainly due to the remarkable freedom from disease that the ostrich has shown under domestication, whilst all other stock in South Africa has suffered terribly from diseases produced by the tick scourge.

Diseases.—As yet the ostrich has only shown a susceptibility to five diseases when farmed in favourable environment. They are :

1. Strangylus Douglassii, by far the most fatal of all. It is a thread worm adhering in great numbers to the gastric glands and killing its host by totally destroying its power of digestion. It was first observed in 1879 ; no cure has been found, and it is very fatal to large numbers of birds when their environment is unsuitable.

2. Yellow fever, an infectious fever in chicks up to four months old ; very fatal with overcrowding or when exposed to excessive moisture.

3. Tapeworm, now nearly always found in large numbers in all ostriches up to two years old ; it is easily kept under by regular fortnightly doses with turpentine, and is only fatal if negleected or when in conjunction with Strangylus Douglassii.

4. Ostrich Fly, a disease that came from the North about twenty years ago. It is becoming worse, and may yet be very serious. The fly is easily killed by spraying with water and 5 per cent. of paraffine mechanically mixed, or by dipping the birds in a decoction of nicotine, but the life history of the fly is not known, and it soon reappears again.

5. Lice found in myriads on neglected birds. This injures the feathers, and reduces the birds in condition. It is easily destroyed by spraying or dipping.

Methods of Farming.—There are now two well-defined methods of ostrich farming, the one grazing them on lucerne fields under irrigation, when five birds to the acre can be kept. The other letting them find their own food in large camps up to 3,000 acres in size and requiring from 10 to 20 acres for a bird. In the first case the drawback is the great cost of sand laid down with lucerne and under permanent irrigation, it running from £50 to £100 per acre. In the latter the greater loss of birds from accidents and getting lost and the cost of feeding them in very severe droughts. Oudtshoorn is the great seat of the industry under irrigation, one quarter of all the birds being found there. The other method being mainly carried on on the west coast of East London and up the large river valleys to an altitude not exceeding 3,000 feet above sea level. The chick feathers are usually pulled when the bird is eight months old, then six and a half months after that the primary feathers are cut, and the tails, blacks, and drabs pulled, and two months later the quills of the cut feathers pulled. This gives nearly three pluckings in two years. Birds should average 1 lb. to 1 lb. 3 oz. of feathers at a plucking, or about $1\frac{1}{2}$ lb. a year. The Census taken in April, 1904, gave 457,970 birds in the colony, whilst the export of feathers for the year was only 470,381 lbs., equal to 1 1·3 lb. per bird, but as from the total number of birds must be deducted those that die during the year and those not arrived at full feather-producing age, the production was fully $1\frac{1}{2}$ lb. per adult bird per annum.

Value.—The value of feathers exported in 1904

was £1,058,988, giving £2 17s. 6d. per bird, including chicks, or about £3 10s. per bird of feather-producing age. The greatest weight per bird of feathers was produced under irrigation or in districts where the veldt is soft. The least weight on hard Karoo and high altitudes. Birds of very superior quality are now being bred, no price being thought excessive for extra superior birds for breeding purposes. A £1,000 was lately given for a pair,* and £200 to £300 is not so very uncommon, whilst the price of ordinary birds is from £5 to £10 each, and chicks £2 to £4. I have mentioned that in the early years of ostrich-farming artificial hatching was very extensively practised. This was owing to the great demand for birds and the very limited number of birds in South Africa old enough to breed, namely, four years. Every effort was made to get the greatest possible increase, and this was obtained by heavily feeding the old birds and not allowing them to sit—they kept on laying all the year round. But as the number of old birds increased and the value of chicks decreased, it became less profitable, and a great tendency to yellow liver sickness was shown when excessive number of chicks were reared by hand on one homestead, and now the practice has been quite abandoned, and the hatching and rearing is done entirely by the parent birds. The birds begin by laying in July, and lay from twelve to sixteen eggs, and hatch in six weeks, the hen sitting by day and the cock by night, excepting in wet weather, when the cock will sit day and night.

Difficulties of Domestication.—One of the difficulties of the farmer, especially when letting his birds graze in large camps on the natural veldt, is the tendency of the birds to get wild and unmanageable, bnt this tendency is not so bad as it was in the early days. When first a brood of chicks is approached, and the parent bird gives the note of alarm, they all run, and drop flat in the first little depression they feel in the ground; when picked up, they remain limp and sham being dead, exactly the same as wild chicks do. But as soon as the parent birds allow a man to approach them and they begin feeding round him, the chicks quickly imitate their parents, and in a few hours show no more fear of man than is shown by the parent birds. If two lots of chicks are taken straight away before they have left the nests and put with another lot of chicks, they will all be equally wild, or tame, as the foster parents are, no matter how wild their real parents may be. The hen bird when sitting is perfectly tame and harmless, but as soon as the chicks hatch she is very fierce. I once had a curious example of this change in the hen, some men were working at a fence close to a sitting hen, and she paid no attention to them, till one day she sprang from her eggs, knocked a man down, very severely injuring him; on examining the nest I found a chick in one egg squeaked, and this had caused the sudden change in the parent hen. The cock bird is always savage during the sitting, and will fight furiously to keep men away from his nest, but when once you are at the nest and begin handling the eggs he ceases to fight, and adopts a piteous, supplicating manner as though beseeching you not to break his eggs, but directly you put the eggs down and begin retreating from the nest he fights worse than before.

The process of sexual selection by which the stamina of the bird and the beauty of the feathers is kept up, is very marked in the ostrich. Breeders who carefully select and separate pairs in coops are met by considerable difficulties. A cock and a hen, both very superior, and from well established strains, may be mated, and the resulting chicks be very disappointing, and it may be years before mates for either of them will be found to produce satisfactory chicks. When a pair are satisfactorily mated, the strain is easily maintained by inbreeding, but the usual consequences of inbreeding, weak constitutions, barrenness, or chicks difficult to rear, soon show.

Future Prosperity.—In 1880, with an annual production of 163,065 lbs. weight, the export value per lb. was £5 8s. 4d.; in 1894, twenty-four years later, the production was 470,381 lbs., with a declared export value of £2 5s. per lb., so that in twenty-four years the production had increased nearly three-fold, and the price had fallen to nearly one-third, and on the first flush it would look as though further increased production would be followed by a corresponding fall in value, but this will not necessarily be so, as during the last twelve years, although the production has been steadily increasing, the value per lb. has remained much the same, and it looks as though the world's increased demand was able to absorb the present rate of increased production, and it is doubtful if South Africa is capable of increasing the production at the same rate as in the past twelve years. The best of the country for ostrich farming, that is, where the rainfall is not over 20 inches, with a rich soil, sheltered from high winds, and no extremes of temperature, is now fairly fully stocked, and further increase must come from sorts not so well adapted for the industry, or from more land being put under irrigation and lucerne, but the physical difficulties are such that this can only be very slowly extended. It would therefore seem that, as far as the capabilities of South Africa go, the rate of increased production is not likely to exceed the requirements of the trade. With the very superior feathers the Cape Colony is now

* It was Mr. H. M. Blomfield, of Graham's Town, who gave the record price of £1,000 for a pair of ostriches. He gave some details respecting them which were printed in the Cape *Midland News*. He wrote:—"I have named the pair of birds 'Record,' which I think they have fairly earned. I bought the first brood of ten chicks the pair produced, giving £20 each for them, or £200 for the ten at six months old. I clipped the Spadonas and put them on the Graham's Town show, taking first prize with them, and sold the feathers, which brought in £1 2s. 6d. per chick. I sold the first after chicks for £10 per bird, or £100 for ten. The second after chicks brought in £11 per bird, or £110 for the ten, and have now sold the ten birds for £50 each, or £500 for the ten. There were six cocks and four hens in the ten.

beginning to produce it is probable the trade will demand better feathers and neglect inferior, and as the Cape exacts an export duty of £100 a bird, these superior birds will only be found in South Africa. There are also great difficulties to be overcome in starting the industry successfully in other countries; as we have seen, the birds during the breeding season are very fierce and dangerous, and it is difficult to get labourers not used to the work to have anything to do with them. Besides which there are few industries in which the skill and knowledge of the directing head has so much to do with the success of the undertaking. Not only to establish but to maintain a troop of birds up to a good standard requires the constant weeding of inferior birds, and in a new country with no outlet for the weeds the birds would rapidly deteriorate. It may be said that all these difficulties had to be overcome in the Cape Colony, but for the first few years after the industry was started the birds produced from £10 to £12 value at a plucking, so that costly mistakes could be easily borne, but now with pluckings averaging £3 a bird any costly mistakes would make it a non-paying industry. So that we may presume that there will not be any sudden or large production from other countries, and the industry will continue to be very lucrative in the colony for many years.

Mr. A. H. Evans also read a paper on "The Ostrich and its Allies," in which he said that this particular genus of bird had clearly descended from ancestors which possessed the power of flight, because the bird and its allies still retained traces of the flight muscles. These ancestors, however, probably never reached the highest power of flight, but a retrogression of this power undoubtedly took place when the birds found an easy life and absence of rivalry, inducing an increased bulk of body, until the utmost exertion could no longer maintain them in the air.

The ostrich was unique among birds in possessing only two toes; the rheas, emus, and cassowaries had three. The ostrich was well-known to the ancients, as was proved by monuments and inscriptions, not to mention the Bible. It was also proved that the ostrich ranged in prehistoric time in Europe and India, from the Miocene of Samos and the Siwalik Hills; while a fossil egg from South Russia has been attributed to a supposed species.

INDUSTRIAL REVIEW OF SOUTH AUSTRALIA.

In common with the returns issued by the Governments of New Zealand and New South Wales respectively, to which reference has been made in recent issues of the *Journal*, the Statistical Register of South Australia* deals at length with the nature and value of the local products, both agricultural and manufacturing. In general outline the agricultural returns are arranged on much the same bases save that more emphasis is given to *fruit culture* than in either of the other colonies named. The acreage devoted to gardens amounted to 9,964 acres, to orchards 13,725 acres, and to vineyards 22,617 acres. There were in gardens and orchards 178,535 almond trees, which yielded 6,585 cwt. of produce; 586,217 apple trees, which yielded 326,324 cases of apples; 141,856 orange trees, which yielded 97,717 cases; 67,882 lemon trees, which yielded 40,315 cases; while 11,864 gallons of olive oil were obtained from 80,560 olive trees. In the vineyards 10,380,926 vines were enumerated as bearing and 1,853,810 as not in bearing; the quantity of wine made from the vintage of 1903 amounted to 2,345,270 gallons, there being also obtained 260,544 cwt. of grapes sold to sundry purchasers, 13,063 cwt. of raisins made, and 10,406 cwt. of currants.

Grain Crops.—The total acreage of wheat sown in 1903-4 was 1,711,174 acres, while 1,593,830 acres were reaped, the yield in bushels being 13,209,465. Barley was cultivated on 28,697 acres, the yield being 487,920 bushels. Oats were grown of 57,588 acres, the yield 902,936 bushels. Hay was cut on 370,152 acres, the total produce being 479,723 tons.

Live Stock.—All round increases are reported in regard to live stock, horses amounting to 176,648, milch cattle to 83,348, other horned cattle to 161,262, and sheep to 5,298,720. With the increase in the number of milch cattle the output of dairy produce has also increased. The weight of butter produced amounted to 5,995,756 lbs. and cheese to 972,584 lbs. The amount of wool produced in South Australia was 39,281,604 lbs. (an improvement on preceding years, but less than the heavy yields in 1894, 1895 and 1896). The amount of wool exported is recorded as 128,503 bales, valued at £1,454,492.

Spirits, Wine and Beer.—The quantity of proof spirit produced amounted to 201,407 gallons, of which 49,945 gallons (valued at £14,960) were exported. The excise duties collected from the 63 stills licensed was £28,220. As regards wine, the output of the 12 licensed stills was 2,573,424 gallons, of which slightly over one-fifth, or 561,830 gallons (valued at £94,660) was exported. The number of breweries was 21; these produced about 2,800,000 gallons (42,661 gallons for export), and yielded an excise revenue of £34,625.

Minerals.—It is only in regard to copper that any detailed returns are afforded. The amount of copper exported was 129,812 cwts., valued at £417,116, and 7,069 tons of ore, worth £54,920. The value of the remaining minerals exported was only £38,978.

Manufactories.—The industry treated the most exhaustively in this return is that of milling: 61 steam driven mills, containing in all 50 pairs of stones, and 420 sets of rollers, contain an aggregate of 2,356 horsepower and employ 496 men and 8 women. Apart from this, there are 1,657 factories of various kinds, em-

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ploying 14,932 males of over sixteen years of age, and 1,070 under that age; 3,613 women over sixteen, and 434 under sixteen. These are mainly engaged in supplying local demands, such as for agricultural implements, boots, shoes, bricks, bicycles, clothing, cement, printing, leather goods, tanning, and so forth. The only industries employing over 1,000 adult males, are (a) those of iron foundries and mechanical engineering, which employ 2,664 adult males, and (b) that of smelting, which employs 2,000.

External Trade.—The total import trade amounted in 1903 to £6,618,267, of which the re-exports amounted to £3,142,926, leaving a nett value of imports retained for home consumption of £3,475,701. Exports of South Australian produce amounted to £5,157,519. Of the total external trade, which amounted in the aggregate to £14,919,072, no less than £12,977,821 was done with the remainder of the Empire. The total trade with the remaining countries in the Commonwealth amounted to £8,151,690, and with the United Kingdom, to £3,716,261. The total trade with the chief foreign countries, was:—Belgium, £341,564; France, £342,216; Germany, £442,351; and the United States, £406,423.

THE EXTENSION OF BRITISH TRADE IN SPANISH AMERICA.

Some very excellent suggestions have been made by the American Consul at Callao for the extension of the export trade to Spanish America, suggestions which might with advantage be taken into consideration by British exporters. The Consul says that he is in receipt, week by week, and mail by mail, of requests from manufacturers and merchants in the United States, varying from a polite invitation to address and post to people in Peru circulars enclosed by the writers, or an equally courteous demand that he should "hand this letter and price list to some one interested," to an appeal for "lists of all exporters and importers of the country, with a few remarks as to their business standing." The American Consul is not singular in this respect, as his experience is undoubtedly that of his British *confrères* in Spanish America. It is needless to expatiate upon the futility of such methods. To begin with, as the printed matter is almost invariably in the English language, it is certain to convey absolutely no information to the person to whom it is addressed, and it is frequently unaccompanied by illustrations. Some years experience, and more or less close contact with trade in Spanish American countries, has led the Consul to believe that the advertising of goods, wherever it is successfully carried on, has been accomplished by the gifts of small trinkets, or by pictorial methods — picture cards, booklets, plaques, chromos, and particularly by illustrated almanacks and calenders, all highly coloured; also by posters. Military and naval subjects, and portraits of popular actresses seem invariably to be found most attractive. There have been many instances where in the interior of Porto Rico and Cuba, in the Artibonite, Haiti, in the port of Santa Marta, Colombia, in the hill country of Nicaragua several days' horseback journey from the coast, the Consul has been greeted by the sight of a patent penknife or corkscrew sent with the compliments of some firm, or was referred to some almanack printed in Spanish and devoted one-third to information, and two-thirds to lauding so-and-so's cutlery, or machinery, or cottons, or was confronted by a familiar highly coloured poster which had attracted the eye, and had been treasured as a picture with which to adorn the walls. These things had evidently fulfilled their purpose. If merchants at home were to bear this in mind much useless trouble and expense would be saved them. To be sure there are many countries in Spanish America where advertising by the means of trinkets offers obstacles—customs duties, often levied on gross weight proving a great bar. But with printed matter the same objection does not hold good, such being almost invariably admitted duty free. The desideratum is to find a pattern which will catch the eye and please the popnlar taste, as well as prove intelligible to those whom it is intended to reach—something in fact which shall be preserved for constant reference and not tossed aside. Considering the fad for collecting pictorial postcards which at present exists, and for some time has existed in Spanish America as well as in Europe, it would seem that this might offer a valuable medium for advertising a firm's goods. A number of prominent hotels and business houses in Spanish America have already taken advantage of this medium, and their advertisements, got up usually in the form of street scenes (showing incidentally their own establishments adorned with a prominent sign board) printed on the back of ordinary postcards, are treasured in the albums of many families. There is here an opportunity for hotels, railways, and steamship lines to Spanish America (all large advertisers), as well as numberless other branches of trade, to gain an entry before a new public. The work, it is said, need not be expensive, as the mere reprinting of the cuts used in the advertising pages of our prominent journals would prove attractive enough, although the printing of such matter in colours would be much more effective.

THE ZAPUPE FIBRE INDUSTRY OF MEXICO.

Among the diversified products of Mexico, none, it is said, will, in the near future, figure more promithan the fibre extracted from the zapupe plant. The

fibre extracted from this plant has been employed by the Indians for centuries, in the manufacture of various articles, such as rope, bags, lariats, bridles, and cordage. The zapupe fibre possesses many advantages over similar fibres, and its pronounced merit as a commercial article will, according to the American Consul at Tuxpam, inevitably render it a source of great wealth to the district of Tuxpam, where it appears to be indigenous. A tract of land exclusively devoted to its cultivation, and, for experimental purposes, is now in full bearing, and the results obtained have surpassed the most sanguine expectations. The zapupe is similar in appearance to the henequen plant of Yucatan. The leaves, however, are longer. Leaf for leaf it produces slightly less fibre than the henequen, but the total yield of fibre is greater, owing to the fact that there are double the number of leaves on the zapupe plant, which will yield from seventy-five to eighty. Its fibre is white, when properly extracted, resistant and flexible. Rope made from it does not kink and mildew when exposed to dampness or immersion in water, and will freely run through ship blocks and pulleys, in which respect much difficulty and annoyance have been experienced with inferior fibre. Zapupe will yield the first cutting of leaves three years from the time the young shoots are planted, and has a great advantage in this respect over other fibre-producing plants, which, as a rule, attain their period of production in five to seven years. From the first to the third year after beginning to yield, it will produce one hundred to one hundred and ten leaves annually, gradually decreasing to about seventy-five, and retaining that production consecutively for fifteen years. The fibre extracted will on an average be from two to three pounds annually, for each plant, although in exceptional cases where the plants have been given special attention they have produced as much as four pounds. The leaves may be harvested throughout the year, from twenty to twenty-five leaves being cut every ninety days. If the leaves are not cut regularly the life of the plant will be materially shortened; at the end of five to seven years it will throw up from the centre a long stem, about eight feet high, and will shortly thereafter cease producing leaves, and die. If the leaves are constantly cut this does not occur until the fifteenth year, and frequently not until the eighteenth year. Branches develop from the summit of the stem, and in time become diminutive zapupe plants, which eventually become detached, and are scattered over the ground, where they take root and become strong, vigorous plants. This stem produces nearly two thousand five hundred of these tiny shoots; in addition to this, numerous shoots spring from the roots of the stump. The plant requires but little attention. After the land has been cleared, and cuttings planted, it is necessary only to keep the young plants free from weeds. After the second year little or no cultivation is required, as their shade will check all undergrowth which might be injurious to them. When vegetation is very rank, it may be necessary to give the land a light clearing once a year, to permit labourers to pass freely from plant to plant to cut the leaves. This is a very simple operation, as the labourers are supplied with a long bladed knife, having a sharp hook-like curve at the end, which is introduced between the stump and the leaf, and with a dexterous upper jerk the leaf is cut off close to the stump. This is essential, as an uneven ragged stump will deteriorate and often die. After the required number of leaves are gathered in lots of fifty, the long needle-like apex is cut off in each case, and the leaves are made up in bundles, tied, and carried to the cleaning shed, situated so as to be within convenient reach of the plants. The machinery is either of the old plain type, with a capacity of cleaning three thousand leaves in ten hours, or of the modern type, with a capacity of one hundred thousand leaves in ten hours. The leaves are fed at the receiving table of the machine, and the perfectly cleaned fibre is delivered at the outlet, as fast as one man can handle it. The plain machines cost from £60 to £100, and the large automatic machines from £400 to £600. A plant one year old will produce fibre within two years. The cost of such a plant is about three-halfpence; smaller plants may be had for half this price. With the cost of labour only about two shillings a day, and the labourer boarding himself, it is estimated that the cost of producing one pound of fibre is from one penny to one penny farthing a pound, delivered on board. As the plants approach their final leaf production, care is taken to plant young shoots between the rows of old plants, so that they will reach maturity as the others die off. The plant is extremely vigorous, as the shoots can be removed from the ground, allowed to remain under cover for weeks without the least care, and when planted will grow well and suffer no evil effects, The zapupe will thrive in almost any district, and apparently does well on all kinds of soil, but seems to prefer a slightly sandy and rocky environment. Shade is harmful to it, and wet places which are exposed to continued freshets and stagnant water are fatal to its growth. Slightly elevated ground is preferable, so that drainage will be as perfect as possible. The shoots can be set out at any time of the year, buf the most favourable season is from October to March, as grass and weeds are then of slower growth, on account of the cessation of the rains. Owing to the powerful needle-like thorn at the end of the leaves, and serrated edges, the plant is shunned by cattle ot all kinds after the leaves have reached their full development. This in itself is an important factor in its cultivation, as fencing becomes unnecessary, providing the young plants can be protected until they are two years old. After this period all animals avoid the zapupe fields. It is remarkably exempt from disease or attacks of insects or rodents; drought does not affect it, or heavy tropical rainfall prove injurious providing it has good drainage, and unlike almost all other agricultural products, it is not absolutely necessary to cut the leaves on any specified day, week, or month. If, owing to unavoidable obstacles, the

leaves cannot be gathered when they have reached the proper condition for fibre extraction, they may be allowed to remain on the stump two or three weeks without any apparent injury. This is a great advantage to the zapupe planter, who can choose his own time to remedy defects, to control his labourers in case they refuse to work or demand higher wages, or he can if so desired, wait for more favourable market conditions. The Consul says that a company has been recently formed at Tuxpam, for the cultivation of the zapupe plant on a large scale. Sufficient capital has been subscribed to commence operations at once. Several plantations have been started, and others will be developed in the near future. It is, he adds, safe therefore to assume that in a comparatively short time zapupe fibre will become the principal article of export from the port of Tuxpam, which must necessarily derive many benefits, and material advantage from this source of wealth.

AUSTRALIAN COTTON CULTIVATION.*

There exists a strong probability that in the near future, cotton, like wool, may become one of the staple products of the Australian Commonwealth. The suitability of soil and climate for cotton growing in the greater part of Queensland, Northern West Australia, and the vast Northern Territory of South Australia, has long become placed beyond all dispute; but the paucity of population, apart from other considerations, has hitherto formed an obstacle in the way of any extensive development of the industry. In the Northern Territory the cotton plant has disseminated itself without the assistance of man, and may almost be regarded as a portion of the North Australian flora, no less than seven out of the eight known species being in that country. Some years ago it looked as if cotton cultivation were destined to become general in Queensland, and a cotton mill was established; but low prices, insufficient capital, and want of experience led to heavy losses, which discouraged cotton growers and caused them to take to dairy farming and other rural industries. Things are changed now. Queensland farmers believe in the possibilities of cotton cultivation, and are prepared to undertake it on an extensive scale if assured of a sufficient supply of labour during the picking season. There is no need for the employment of coloured labour, but the white labourer is apt to weary of the monotony of his occupation. An average farmer's family could readily work an area of from five to ten acres, in addition to other farm work. The same remark applies also to Northern Australia generally. The cultivation of cotton, we are told, seems to be the best complement of cane growing. The cane is a scrub plant, thriving best when close together, and is admirably suited to be grown on the heavy scrub lands, whilst the cotton is essentially suited for being grown on the lighter forest lands. In the coming time it will be found necessary to irrigate all cane lands; but the cotton will not absolutely require irrigation. In the cane-growing districts there is a very large proportion of the land unfit for growing cane. Even the richest red soil forest lands, though they grow splendid cane for a few years, are very quickly exhausted for that culture; but these form the very best soil for cotton growing. The table lands of Northern Queensland have been proved to be admirably suited for growing the high-class cottons. The possible returns, even at a low market price, from an acre of cotton are estimated at £15. A Queensland scientist, Dr. Thomatis, who has devoted much time and money to experimental cotton growing, has evolved an apparently promising variety of cotton by hybridisation, which he calls "Caravonica." This new species is described as having a "staple very long, strong, regular, and of a woolly appearance, so that it can be used as a substitute for wool." The new cotton is now regarded by American and other growers as the best yet known. There are two varieties of the new Caravonica, one forming, as above-mentioned, a kind of substitute for wool; the other being of a silky texture and very superior. What Dr. Thomatis has produced of it from time to time has been sold up to 1s. 6d. per lb., and there are orders for all that can be grown at that price. The first-named kind has the advantage that, instead of being an annual, as are those varieties mostly raised in America, it is, in truth, a perennial tree. The labour of annual planting is, therefore, avoided, and all that is required is to keep the plantations clean in the same manner that orchards are. It is a rapid grower, and in twelve months reaches a height of seven feet, and then yields a small crop; but it continues to grow, and in a year or two more yields enormous crops. Commenting on these facts, we are told that they indicate a splendid future for the great northern areas of the Commonwealth. The demand for cotton is ever increasing. It has already more than overtaken the supply, and is still increasing, and will continue to year by year as the great markets of Asia and Africa are opened up. Since 1887 the consumption has increased by 200,000,000 lbs. per annum, and yet the price of the raw material has doubled in the past few years. There is, however, a practically unlimited market for whatever Australia may be able to produce. The climate of the Australian cotton-growing districts has been found not only endurable, but healthful to Europeans who have lived there for various periods up to twenty-five years. Moreover, whatever may be the assertions as to the work in the sugar-cane fields not being suitable to Europeans, it certainly does not apply to the cultivation of Carvonica cotton.

* Communicated by Mr. John Plummer, of Sydney.

HOME INDUSTRIES.

The Tin-plate Trade.—Nothing in the commercial history of the United Kingdom in recent years is more remarkable than the recovery in the tin-plate trade. A couple of years ago, it was supposed by many authorities to be in a dying condition, and the position was certainly very depressing. The McKinley Tariff, that of 1900, dealt it a staggering blow. The market was a very narrow one, being mainly dependent on the United States. Immediately prior to the McKinley Act our exports of tin-plates to the United States had averaged 304,695 tons in weight, and £4,278,667 in value, and to all other foreign and colonial markets the exports averaged 94,634 tons, and £1,403,974 in value, giving a total export of 399,329 tons in quantity, and of £5,682,641 in value. Then the trade with the United States fell away, and has not been recovered. Last year the United States took only 71,994 tons in quantity, and £891,591 in value. But our manufacturers were equal to the occasion. One market was lost, but others were found. Figures given in a valuable article in *The Times* commercial supplement on the subject show that our export of tinned plates in 1904 amounted (including black plates for tinning) to 422,163 tons, of the value of £5,197,447. When the foreign trade in black plates is taken into consideration, it is the opinion of Sir John Jones Jenkins, an acknowledged authority on the subject, that the industry is to-day greater and more prosperous than it has ever been in its history. And it is no longer, as in the old days, dependent practically on one market. As compared with 1890, our trade with the Colonies and India in tin-plates in 1904 was 155·9 per cent. larger; with Germany, 233·2 per cent.; with Belgium, 129·9 per cent.; with Holland, 302·8 per cent.; with France, 92·9 per cent.; with Italy, 29·5 per cent.; and with Russia, 16·6 per cent.

Galvanised and Corrugated Iron Sheets.—Another trade closely allied to the tin-plate has had a similar experience. Although of comparatively recent origin, the manufacture of galvanised and corrugated iron sheets is now one of the most important metallurgical trades. Sir Charles McLaren has an interesting reference to it in the Engineering Supplement of *The Times.* With some firms, such as the Pontynister Works, it has taken the place of steel bars. In 1899 the exports amounted to 238,013 tons. In 1904 they reached 385,448 tons, an increase of 60 per cent. in five years. The process of manufacture is similar to that of tin-plates, the difference arising only in the last stages, when the black plates which have been rolled out for the steel bars are converted into "galvanised" iron instead of into "tin-plates." The Newport district contains some of the largest works of this description in the country, viz., those of Baldwin's, Limited, at Panteg and Pontypool, and those of John Lysaght, Limited, at Newport. These works employ over 2,000 men, and both concerns are very successful from a shareholder's point of view. The removal of Lysaght's from Wolverbampton to Newport, on the seaboard, is another instance of the difficulty of carrying on a profitable trade where carriage has first to be paid on raw materials, and again on the finished product to the port of shipment.

Electricity and Textile Manufactures.—We are not accustomed to look to Portugal for a lead in industrial matters or to consider her at all in connection with textile manufactures, and yet an announcement comes from that country to which the attention of Lancashire may well be directed. It is to the effect that the first mill erected for spinning cotton thread has been furnished with a complete outfit of electrical machinery and apparatus by a British firm. In the new mills now being erected in Lancashire, in numbers unequalled in recent years, a noteworthy feature of several of them, as was pointed out on this page last week, is the substitution of electricity for the fly wheels, belting, and long lines of shafting for conveying suction from the engines to the machines. But what of the older factories? If they are to hold their own with competitors abroad—yearly becoming more formidable—they must have the most up-to-date equipment. Naturally, the older factories are unwilling to convert their power system, which means heavy expenditure, if it can be avoided. But can it? Much of the success of American manufacturers has been due to the unhesitating way in which they sacrifice machinery that has become only second best for the best, regardless of cost. The tendency in this country, even in Lancashire, is rather in the other direction, to somewhat excessive unwillingness to incur large outlay for the purpose of being equipped with the very latest and best machinery. But this has to be done if England is to hold her own in the industrial world, and when Portuguese mills are electrically driven Lancashire spinners can hardly have any doubt that the time has come for them to convert their power system.

The Motor Omnibus Industry.—Reference has been made more than once on this page to the opinion of the Royal Commission on the means of locomotion and transport in London that it is not probable that motor omnibuses will supersede electric tramways as a means of conveying a large numbers of passengers. They may not supersede them, but that they will convey "large numbers of passengers" is no longer open to doubt. It has been estimated that the horse omnibuses working in the streets of the metropolis carry 600,000,000 passengers per annum, and it is expected by experts that within three years the motor vehicles running in the metropolis will be sufficient to carry that number of passengers. The motor omnibus carries 34 passengers against the 26 of the horse omnibus for a distance of 130 miles as against 70 miles. The London Motor Omnibus Company began running its "Vanguards" in April last. Starting with three, it has now 46 on the road, and by the

end of next year it is expected to have 350 at work. The London District Motor 'Bus Company, owning the "Arrow" omnibuses, has already 15 motors on the road, and will soon have 100. The London General Omnibus Company, the London Road Car Company, Tillings, all have large orders on hand for motor omnibuses, and before many years have passed the horse omnibus will no longer be seen on London streets.

British Manufacturers and the Industry.—The Motor Car Exhibition at Olympia, opened last week, is at once encouraging and disappointing. It is encouraging as showing that British firms are now able to turn out motor-cars not inferior to the best of the motors put upon the market by the foreigner. Thirty years ago the British manufacturer would not have been content to catch up the foreigner after giving him the lead for many years in an important industry, but it is only fair to him to remember that he was greatly hampered by the state of the law, and that it is only within the last ten years that the regulations have been more in consonance with public requirements. If, however, the British manufacturer is no longer unable to compete with the foreigner in the manufacture of costly private cars, he is still without any share of public conveyance work. There are plenty of motor omnibuses at Olympia, and this branch of the trade is making rapid advance, but the fact remains that all the motor omnibuses now on the streets are of foreign make, and that hitherto British manufacturers have failed to effectively compete with the best *châssis* makers of the Continent for this particular work. It may be hoped that here, too, the British manufacturer will soon be, where he ought to be, in the front rank. It is an enormous industry, this motor industry, that is opening out. Mr. Stanley puts the present value of the cars in the United Kingdom at £15,000,000, and the estimated output for the next twelve months at £2,000,000. The industry already means work and good wages for thousands of the workpeople of the United Kingdom.

The Leather Trade.—Reference was recently made in the *Journal* to the intended migration of Yarrow's from Poplar, and to the number of manufacturing firms which in recent years have left the East-end of London for other parts of the country. It is much the same with the leather trade in Bermondsey. There are a good many firms still in the district who dress leather, but most of the tanneries have gone to Leeds. The leather trade, like others, suffers from "dumping." American, German, and French imports have made an end to the substantial profits of other times. Nowadays there is more money made in buying and selling than in tanning. An American trade paper makes a statement worth quoting in this connection:—"Technical education," it writes, "will pay. Chemists and tanning experts in Peabody tanneries get from $3,000 to $5,000 a year, and it is said by these experts that there is room for much improvement in the chemistry of the tanning trade." The Leathersellers' Company are moving in the right direction. In the Herold Institute they have created, and are maintaining, a technical school that should be of great value to the trade.

Hop Profits.—As anticipated in the *Journal* of November 3 the price of hops remains very low, with hardly any variation from the figures there given. A comparison of the results of last year's hop crop with that of this year will show how little the hop growers' profit depends upon a large yield. Speaking roughly, the yield of 1904 was 6 cwt. per acre, and of 1905 15 cwt., whilst the price in 1904 was, say, roundly, £10, as against (again very roughly) £3 10s. in 1905. Upon these figures an acre of hops would have given the grower last year £60, and this year only £52 10s. But this is not the extent of the difference to the prejudice of 1905 and its big crop. The expenses of picking, drying, packing, carriage, sampling, selling, &c., on an average crop of say, 7 cwt. per acre, may be put down at £10. The charge last year must have been something less than that. But this year it would be nearly double. Assume, however, a difference of only £5 an acre, and it works out at £47 10s. per acre, as against £60 last year, when the crop was considerably below an average one, whereas this year it is more than double the normal. An exceptionally fine year is absolutely disadvantageous to the hop-grower, since the fall in price more than counterbalances the increased production.

Bond Investment Companies.—The recommendations of the Board of Trade Committee appointed to inquire into "the operations of companies (not being life assurance companies) which collect periodical payments from the industrial classes, in return for benefits promised in the future, have just been published, and accord with the views of leading experts who had previously considered the subject. Roughly, the committee recommend that these bond investment companies shall be under regulations somewhat similar to those by which life assurance societies are bound under the Life Assurance Act of 1870. The deposit is indeed smaller (£10,000 instead of £20,000), but it is snbstantial. This deposit is not to be paid out until a sum is set aside and secured for bondholders amounting to double the sum deposited. It is further recommended that every bond investment company shall be required to prepare a statement of its revenue account and balance-sheet in a form to be prescribed and similar, with the necessary modifications, to that prescribed by the Life Assurance Act, 1870, and once at least in every five years to cause an investigation to be made into its financial position by an actuary. Also it is recommended that every such company which may be formed in the future, shall be prohibited from adopting any system of redemption, or advances without

interest, and that power shall be given to the Court to order the winding-up of any such company, on the application of one or more bondholders, upon its being proved that the company is insolvent.

GENERAL NOTES.

The Philippine Islands.—Mr. Consul-General Kenny's report on the trade of the Philippine Islands for 1904 (No. 3512, Annual Series), shows, in a very striking way, how the American occupation of the islands has assisted American trade. Take hemp. In 1900 the United States imported 20,304, and the United Kingdom 46,410; in 1904 the American import had increased to 59,402, and that of the United Kingdom to 53,100 only, the supremacy of the United States trade being due to an Act passed in 1902 giving an advantage to American cordage manufacturers in direct purchases of hemp. The total value of the imports into the Philippine Islands during 1904 amounted to £5,915,546. The imports from the United Kingdom have steadily declined from £1,138,516 in 1901 to £868,205 in 1904. The trade of the United States was slight before the American occupation, averaging only some £40,000 in the pre-Suez days. Since then, down to 1899, it amounted to double that sum, and only in the year 1882 ever exceeded £200,000, but with imports in 1900 of over £430,000 it has grown until in 1904, amounting to £1,019,764, it exceeds that of all other countries except the French East Indies with their rice shipments, and represents one-sixth of the total. Under an Act of Congress passed in 1904, it was provided that the Coast Laws of the United States shall be applied to the islands after July 1st, 1906. Under a provision of this Act no passenger will be able to journey, for example, to or from either the Pacific or Atlantic coast of the United States to the Philippine Islands in a ship flying a foreign flag.

Pauperism in England and Wales.—The return of pauperism, just issued, show that while pauperism in the present year continues to be in excess of that of 1904, the increase showed some sign of diminishing during the quarter ended September 30th. The total number of paupers in receipt of relief in England and Wales at the end of September was 22·4 per 1,000, which is the highest per-centage since 1897. All told, the paupers numbered 766,198, but if they had been in the same proportion as in 1895, they would have numbered 793,524. In London, the per-centage per 1,000 inhabitants has risen to 25·4, which is higher than for any year since 1874. In that year the per-centage of indoor paupers was only 9 8 per 1,000 inhabitants, this year it is 15·8. The number and rate per 1,000 of the population of the indoor paupers was in London, as in England and Wales, as a whole, higher at the end of each month of the quarter than at the corrresponding dates in any of the preceding forty years. The total number of paupers in receipt of relief in London at the end of September last was 118,829. If the paupers had borne the same proportion to estimated population as in 1895, they would have numbered 106,224 only. The only districts over the whole country which show a decrease at the end of September as compared with the same period of last year are Chester and Lancashire, the decrease in Chester being quite nominal. There is a decrease, taking the same period, of 0·6 in the central district of the metropolis, but the north district shows an increase of 2·2, the south district of 2·4, the west district of 3 4, and the east district of no less than 3,308, or 15·6 per cent. The London percentages compare unfavourably with those of the rest of the country.

Honiton Lace.—With reference to the remarks on this subject that appeared in the *Journal* of September 15th, Mr. Lancaster Lucas, Superintendent of the Shaldon Lace School, writes as follows:—"There is no difficulty in selling all the lace we can make. In fact we have to supplement the work produced in the school by buying from workers at home. The price that we obtain for the made-up lace scarcely represents a living wage to the workers for the 'sprigs' we buy from them, but it is a considerable help, and a woman skilful with her pillow should be able to earn from 5s. to 7s. a week without neglecting her home, that is, of course, if there is a brisk demand for lace. In the case of schools there is no middleman. We sell direct to the buyer and consequently can charge a smaller price. The shops give very small prices for sprigs and make them up themselves, charging very high for completed work. Frequently they sell thread, bobbins, prickings, &c., to the worker. Pins are a large item. Fashion affects the industry greatly. If our Honiton lace became really the vogue we should soon have more orders than we could fulfil. It is very difficult to get the people here to realise that money is to be made by lace work. You see this is the first lace school for poor children that has ever been established this side of Exmouth, so that the children have never seen the work done. In the Beer and Honiton districts almost every woman is a lace worker and the thing is almost born in the children. Of the 17 girls that are on our books there are only two or three who would make good workers. The school is a very great hindrance to us, as we can only get the girls on Saturday, and in the evening, which does not conduce to their learning quickly."

Bananas and Barbadoes.—In his report on the Blue-book of Barbadoes for 1904-5, the Acting-Governor refers to the expansion of banana cultivation which has grown from 18 bunches shipped in 1902 to 15,326 bunches shipped in 1904. It is estimated that at the present time there are about 100 acres of land planted with bananas, and that

40,000 bunches will be shipped during the present year. The difficulties in connection with the packing and carriage of the fruit seem to have been successfully overcome, and a net return of £20 per acre per annum is expected from the cultivation. If anything like this return is realised a very great extension of the cultivation may be expected. Cotton cultivation, taking data obtained from ten estates, each having an average of 9½ acres under cotton cultivation, gave in 1904 a net return per acre of £10 8s. 4d., and sugar, even at present improved prices, gives a smaller net return. If, therefore, banana cultivation can give anything like £20 an acre it should become very general in Barbadoes, to be checked only by the limit of demand which, not only in England but in the United States, is still rapidly on the increase. The banana grown in Barbadoes is smaller and of more delicate taste than the Jamaica product which, until recent years, found a market only in the United States.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock :—

November 29. — "The British Association in South Africa." By Sir William H. Preece, K.C.B., F.R.S. Sir Owen Roberts, D.C.L., Chairman of the Council, will preside.

December 6.—"The Manufacture of Sugar from British Grown Beet." By Sigmund Stein. The Right Hon. the Earl of Denbigh, C.V.O., will preside.

December 13.—"The Commerce and Industry of Japan." By W. F. Mitchell. His Excellency the Japanese Ambassador, will preside.

December 20.—"The Aerograph Method of Distributing Colour." By Charles L. Burdick.

Indian Section.

Thursday afternoon, at 4.30 o'clock :—

December 7.—"The Partition of Bengal." By Sir James Bourdillon, K.C.S.I. The Right Hon. Lord George Hamilton, G.C.S.I., M.P., will preside.

Colonial Section.

Thursday afternoon, at 4.30 o'clock :—

December 14.—"French Canada and French Canadian Ideals." By the Hon. Rodolphe Lemieux, K.C., M.P., Solicitor-General of Canada. The Right Hon. Lord Strathcona, G.C.M.G., will preside.

Applied Art Section.

Tuesday Evening, at 8 o'clock :—

December 12. — "Historical Pageants." By Louis N. Parker. Sir Marcus Samuel, Bart., Vioe-President of the Society, will preside.

Papers for meetings after Christmas :—

"London Traffic." By Captain G. S. C. Swinton (L.C.C.).

"The Preparation of Oxygen from Liquid Air." By Monsieur Raoul Pictet.

"Submarine Signalling." By J. B. Millet.

"The Supply of Electricity." By James N. Shoolbred, B.A., M.Inst.C.E.

"The Planting of Waste Lands for Profit." By Dr. J. Nisbet.

"Industrial Russia." By Lucien Wolf.

"The Horseless Carriage, 1885–1905." By Claude Johnson.

"The Artistic in Painting and Photography." By J. C. Dollman, R.I.

"Illuminated MSS." By H. Yates Thompson.

"The City of Calcutta." By Charles Edward Buckland, C.I.E.

"The Languages of India and the Linguistic Survey." By Dr. George A. Grierson, C.I.E., Ph.D., D.Lit.

"Seistan: Past and Present." By Colonel Arthur Henry McMahon, C.S.I.

"The Navigable Waterways of India." By Robert Burton Buckley, C.S.I.

"The Parsis of Persia." By Major Percy Molesworth Sykes, C.M.G.

"Progress in Electric Lighting." By Leon Gaster, A.M.I.E.E.

"Imperial Questions in the West Indies." By Sir Nevile Lubbock, K.C.M.G.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

J. A. Fleming, D.Sc., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (In continuation of previous courses on "Electric Oscillations and Electric Waves," and on "Hertzian Wave Telegraphy.") Four Lectures.

Lecture I.—November 27.—*Measurement of High Frequency Capacity, Inductance, and Resistance.*—Practical methods of measuring small capacities—Capacity of Leyden jars, aërial wires, antennæ and insulated conductors—Formulæ for capacity of standard forms—Practical measurement of small inductances — Pre-determination of inductances of standard circuits — High frequency resistance—Surface distribution of high frequency currents—Methods of determining spark resistance—Methods of measuring number of sparks per second—Effect of proximity of aërial wires on their capacity and inductance.

LECTURE II.—DECEMBER 4.—*Measurement of High Frequent Voltage and Current.*—Damping of electrical oscillations—Maximum and mean-square values—The damping factor and logarithmic decrement—The resistance decrement and radiation decrement—Damping due to dielectric hysteresis and magnetisation—Methods of determining maximum and mean-square voltage—Spark voltage in air at various pressures—Electrometer measurements—Calculation of maximum currents during discharge—Methods of determiming logarithmic decrements employed by Rutherford, Bjerknes, Drude and others—Analysis of the discharge of a Leyden jar, or condenser.

LECTURE III.—DECEMBER 11.—*Measurement of Frequency and Resonance.*—Time period and oscillation constant of a condenser circuit—Closed and open circuit syntonic circuits—Theory of resonance—Experiments illustrating resonance—Resonance curves—Determination of the total decrement from resonance curves—The Cymometer—Its use for determining small capacities and inductances—Theory of the oscillation transformer—Analysis of the phenomena of the oscillation transformer by the aid of the Cymometer.

LECTURE IV.—DECEMBER 18.—*Measurement of Free and Stationary Wave-Length.*—Stationary waves on wires—Velocity of propagation—Mechanical model—Loops and nodes of potential and current—Special qualities of spirals—Methods of detecting loops and nodes—Radiation from aërial wires—Velocity of free waves—Relations of free-wave lengths to antenna length—Direct and inductively coupled aërials—Determination of the wave-length and damping of the waves radiated from antennæ—Methods of syntonising coupled circuits with the Cymometer.

SIR WILLIAM WHITE, K.C.B., F.R.S., "The Modern Warship." Five Lectures.

January 29, February 5, 12, 19, 26.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

HOWARD LECTURES.

A Course of Three Lectures will be given under the Howard Trust, by PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., on "High Speed Electric Generators, with special reference to driving by Steam-turbines," on the followng Thursday Evenings, at 8 o'clock:—January 18th and 25th, and February 1st.

JUVENILE LECTURES.

Two lectures suitable for a Juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, 1906, at 7 o'clock, by PROFESSOR HERBERT JACKSON, on "Flame and Combustion."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures) J. A, Fleming, "The Measurement of High Frequency Currents and Electric Waves." (Lecture I.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on paper by Mr. John D. Wallis, "The Licensing Act, 1904: with Special Reference to the Questions of Compensation and Monopoly Value."

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Sir Charles Eliot, "The Upper Nile."

TUESDAY, Nov. 28...Alliance Franco-Britannique, at the HOUSE OF THE SOCIETY OF ARTS, John-street, Adelphi, W.C., 8½ p.m. Mons. L. Brandin, "Parnassiens et Symbolistes."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on paper by John Arthur Saner, "Waterways in Great Britain." 2. The Hon. Charles Algernon Parsons and George Gerald Stoney, "The Steam Turbine."

Photographic, 66, Russell-square, W.C., 8 p.m. (Technical Meeting). Mr. R. J. Wallis, "Spectrum Grating Replicas."

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. T. J. Alldridge, "Sierra Leone, and its Undeveloped Products"

WEDNESDAY, Nov. 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir William H. Preece, "The British Association in South Africa."

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, Nov. 30...Royal, Burlington-house, W., 4 p.m. Annual Meeting.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Major Martin Hume, "The Birth of Britain over Seas."

FRIDAY, DEC. 1....Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. W. L. Jenkins, "An Installation for the Bacterial Treatment of Sewage, at Neath."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Architectural Association, 18, Tufton-street Westminster, S.W., 7½ p.m. Mr. E. P. Reynolds, "Turkish Architecture."

Geologists' Association, University College, W.C., 8 p.m. 1. Mr. Martin A. C. Hinton, "Gazella Daviesii—A New Antelope from the Norwich Crag of Bramerton." 2. Messrs. A. S. Kennard and B. B. Woodward, "Sections of the Holocene alluvium of the Thames at Staines and Wargrave."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club. 20, Hanover-square, W.C., 8 p.m.

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FRIDAY, DECEMBER 1, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 4, 8 p.m. (Cantor Lecture.) DR. J. A. FLEMING, F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (Lecture II.)

WEDNESDAY, DECEMBER 6, 8 p.m. (Ordinary Meeting.) SIGMUND STEIN, "The Manufacture of Sugar from British-grown Beet."

THURSDAY, DECEMBER 7, 4.30 p.m. (Indian Section.) SIR JAMES BOURDILLON, K.C.S.I., "The Partition of Bengal."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 27th inst., Dr. J. A. FLEMING, F.R.S., delivered the first lecture of his course on "The Measurement of High Frequency Currents and Electric Waves."

The lectures will be published in the *Journal* during the Christmas recess.

REPORT ON LEATHER FOR BOOK-BINDING.

The enlarged and illustrated edition of the Report of the Committee on Leather for Book-binding is now ready. It is published by Messrs. George Bell and Sons, of York-house, Portugal-street, W.C., at the net price of 10s. 6d. Members of the Society requiring a copy can obtain one, at a discount of 25 per cent., by applying direct to the Secretary of the Society.

UNION OF INSTITUTIONS.

The following Institution has been received into Union with the Society :—

Devon and Exeter Institution, Palace-gate, Exeter.

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, November 29th, 1905; SIR OWEN ROBERTS, M.A., D.C.L., F.S.A., Chairman of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society :—

Barclay, Robert Leatham, M.A., 54, Lombard-street, E.C.
Hellyer, Robert Edgcombe, Farlington-house, Havant, Hants.
Jones, William Herbert, 8, Birch-grove, Rusholme, Manchester.
Nathan, Sidney Herbert, M.D., 50, Harrington-gardens, S.W.
Rhead, George Woolliscroft, Doune-lodge, Oxford-road, Putney, S.W.
Roese, Otto, 4, George-yard, Lombard-street, E.C.
Rogers, L.D., M.A., M.D., LL.D., National Medical University, Chicago, Illinois, U.S.A.

The following candidates were balloted for and duly elected members of the Society :—

Adams, Herbert Jordan, J.P., Roseneath, London-road, Enfield, Middlesex.
Adams, Thomas, Puncharden-hall, Willian, Herts.
Addison, William Henry, Kimberley, Cape Colony, South Africa.
Agnew, Lieut.-Colonel John Vans, I.A., Barnbarroch, Whauphill, N.B.
Allardice, Lieut. William McDiarmid, 14, Newbold-terrace East, Leamington Spa.

Andrews, Francis Emile, Normandie, Newport-road, Cardiff.

Andrews, George F., care of Messrs. Brown Bros. and Co., 59, Wall-street, New York City, U.S.A., and Algiers, Algeria.

Bates, Eneas Percy, B.A., Southwell-villa, New Holland, Hull.

Begg, Alexander Hood, Messrs. Guthrie and Co., Penang, Straits Settlement.

Bennett, F. Dillon, M.R.C.S., L.R.C.P., 34, Weymouth-street, W.

Bolton, George Wilson, A.M.I.Mech.E., The Harbour Works, Colombo, Ceylon.

Bourdillon, Sir James Austin, K.C.S.I., Westlands, Liphook, Hants.

Burkitt, Frank, 8 and 10, Lant-street, Borough, S.E.

Calisch, Lionel, 12, Pembridge-gardens, W.

Calkin, Arthur, 29-33, Heddon-street, W.

Cartner-Dyer, John, 2A, Whitehall-court, S.W., and Cape Town, South Africa.

Chand, Rai Bahadur Gokal, Civil Surgeon, Muzaffargarh, Punjab, India.

Cheesman, Edmund Morton, 63, Railway-street, Durban, Natal, South Africa.

Chenhall, John S., 25, Cecil-road, Seaforth, Liverpool.

Cheyne, Charles August, Heilbron, Orange River Colony, South Africa.

Claxton, Harold, Westville, Crawley, Sussex.

Coats, J. Munro, 26, Upper Brook-street, W.

Contractor, Shivakshaw Hormusji, New Foras-road, Taredeo, Bombay, India.

Cooke, Arthur Clement, 9, Minster-road, West Hampstead, N.W.

Cooper, Frank, R.N.R., 39, Newick-road, Clapton, N.E.

Dâni, Purushottam Ganesh, B.A., 5, Girdlers-road, Brook-green, W.

Das, Gopal Bulhub, M.A., B.L., Gaya (E.I.Rly.), Bengal, India.

Davies, David, Plâs Dinam, Llandinam, Montgomeryshire.

Derwent, Henry C., "Bradford Daily Telegraph," Bradford.

Douglas, Robert H., I.C.R.C. "Kai-Pan," care of Commissioner of Customs, Kowloon, Hong Kong, China.

Edwards, John, Boys' High School, Grahamstown, Cape Colony.

Egerton, His Excellency Sir Walter, K.C.M.G., Government-house, Lagos, West Africa.

Ferguson, Wilfred Henry, 4, Thornwood-terrace, Partick, Glasgow.

Freyberg, Herbert, 24, Cromwell-place, South Kensington, S.W.

Fuchs, Emil, M.V.O., Abbey-lodge, Park-road, Regent's-park, N.W.

Fulton, Otto, F.R.P.S., African-house, High-road, Chiswick, W.

Gage, Captain Andrew Thomas, M.A., M.B., I.M.S., Royal Botanic-garden, Sibpur, Calcutta, India.

Gavey, Arthur, P.O. Box 3003, Johannesburg, Transvaal, South Africa.

Gibson, Edward Marriott, Schlüsselburg Calico Print Works, Schlüsselburg, near St. Petersburg, Russia.

Gillman, Gustave, M.Inst.C.E., the Great Southern of Spain Railway Company, Limited, Aguilas, Provincia de Murcia, Spain.

Grant, Charles Henry, M.Sc., 212, Burley-road, Leeds.

Gundry, Richard Simpson, C.B., Hillworth-cottage, Devizes, Wilts.

Hadi, Saiyed Mohammad Abd-ul, Government Pleader, Muttra City, U.P., India.

Harman, Bruce, 35, Connaught-road, Willesden, N.W.

Hilton-Simpson, Melville W., Sole-street House, Faversham, Kent.

Houfton, Percy B., Chesterfield.

Hunt, Wilfred, 121, West George-street, Glasgow.

Iyer, T. Vencatarama, 44, Coral Merchant-street, Madras, India.

Jackman, Henry Thomas, Public Works Department, Hong-Kong, China.

Jacobs-Smith, George E., Woodfield-lodge, Ditchling-road, Brighton.

Johnstone, John Swanston, Natal Distilleries Company, Bond-street (P.O. Box 120), Durban, Natal, South Africa.

Jolley, Alfred Charles, Northampton Institute, Clerkenwell, E.C.

Kelley, Thomas Stanhope, 14, Springfield-road, Kingston-on-Thames.

Kumm, H. Karl W., Ph.D., Mount View, Castleton, *viâ* Sheffield.

Large, R. Emmott, 1, Verulam-buildings, Gray's-inn, W.C., and Pound Croft Farm, East Hanney, Wantage.

Lawes, George Elliot, M.I.Mech.E., Gefe Traccion y Talleres, Ferro Carril Central Paraguay, Sapucay, Paraguay, South America.

Liang Ming Ting, Taotai, Imperial Railways of North China, Tientsin, China.

Lightfoot, Edward Thomas, Kalmar, Oaklands-road, Bromley, Kent.

Lionnet, Captain J. Joseph Georges, Suez Canal Company (Pension Lafont), Port Said, Egypt.

Loram, Sydney H., M.Am.I.M.E., care of Messrs. Gibbs and Co., Valparaiso, Chile, South America.

Lorie, Sydney, Godwyne-house, Godwyne-road, Dover.

Louis, Adolphus Herman, 2, Plowden-buildings, Temple, E.C.

Lutyens, Edwin L. 29, Bloomsbury-square, W.C.

Mackintosh, Charles Rennie, 140, Bath-street, Glasgow.

Mansell, Andrew Evans, Mount Vernon, Melton Mowbray, Tasmania.

Marshall, Albert Henry, A.M.I.E.E., Avondale-villas, Drummond-road, Romford.

Martin, Richard Harrington, Trichinopoly, South India.
Marty, Ernesto, Calle Lorea 2051, Buenos Ayres, Argentine Republic.
Mason, Henry Trood, 26, Albion-street, Hyde-park, W.
Mathews, Robert St. John, 36, Ashley-gardens, S.W., and 117 Leadenhall-street, E.C.
Millroy, Alfred T., 1, Enid-street, Liverpool.
Mills, Herbert H., M.D., 21, St. Mary Abbot's-terrace, Kensington, W.
Mizzi, Lewis F., LL.D., Constantinople, Turkey.
Modi, Dr. Edalji Manekji, M.S.C.I., opp. Grant-road Railway Station, Sleater-road, Bombay, India.
Norton, Frederick William, Assoc.M.Inst.C.E., Calle B. Mitre 299, Buenos Ayres, Argentine Republic, South America.
Oliphant, Arthur C., 8, Stanhope-street, Hyde-park-gardens, W.
O'Shaughnessy, John William, Madras Salt, Akbari and Customs Department, Bangalore, South India.
Othen, John, 27, Chancery-lane, W.C.
Parker, Frederick, Wallasey-house, Boston, Lincolnshire.
Paul, J. David, M.A., King William's College, Isle of Man.
Perks, Frederick John, 48, Grove-park, Denmark-hill, S.E.
Perry, Charles Percy, Welford-house, Springfield-road, King's Heath, Birmingham.
Peters, Thomas, 21, Washington-road, Sharrow, Sheffield.
Pezzani, E. R., 36, Porchester-square, W.
Phillippo, Ernest C., Public Works Department, Lagos, West Africa.
Pinches, John H., 21, Albert-embankment, S.E.
Plaskitt, Frederic J. W., 27, Great Percy-street, W.C.
Porter, Robert P., 108, Banbury-road, Oxford.
Preston, Hon. Jenico E. J., Gormanston-castle, Balbriggan, Ireland.
Probyn, His Excellency Leslie, C.M.G., Government house, Sierra Leone, West Africa.
Pugh, Charles Vernon, Radford-house, Coventry.
Ram, Rai Sahib Tej, Divisional Engineer, Irrigation Division, Jammu, Kashmir State, India.
Rathbone, Richard Ll. B., 174, Buckingham Palace-road, S.W.
Reddie, Miss Marion C., care of The Manager, London and Provincial Bank, Richmond, Surrey.
Reid, John T., Lovelocks, Nevada, U.S.A.
Rigby, Thomas, Messrs. Crossley Bros., Openshaw, Manchester.
Rimmer, Joseph Thomas Marshallsay, F.C.I.S., P.O. Box 1016, Cape Town, South Africa.
Robb, John McLorinan, Ashurst, Glastonbury-avenue, Belfast.
Robinson, Rev. F., Euroa, Victoria, New South Wales, Australia.
Salter, John Russell, M.I.E.E., 9, North John-street, Liverpool.
Scott, Dunbar D., Houghton, Michigan, U.S.A.
Shanan, Charles Henry, Assoc.M.Inst.C.E., A.M.I.E.E., A.M.I.Mech.E., Gorge Head, Mussoorie, U.P., India.
Shorter, Lewis R., B.Sc., 55, Campden-hill-road, W.
Sibbald, Thomas Knight, Messrs. Cook and Son (Egypt), Limited, Boulac Engine Works, Cairo, Egypt.
Smith, Henry, 5 and 6, Clement's-inn, Strand, W.
Smith, Percy, 42, Campden-hill-court, Kensington W.
Stevens, T. H. G., care of Messrs. Scott and Co Bankers, Rangoon, Burma.
Sticht, Robert Carl, The Mount Lyell Mining and Railway Company, Limited, Queenstown, Tasmania.
Stigand, Ivan A., F.G.S., Balek Papan, Oost Borneo, Netherlands East Indies.
Stretton, Walter Robert, 4, Queen-street-place, E.C.
Strutt, William, R.B.A., F.Z.S., Queenhoo, The Hemicycle, Wadhurst, Sussex.
Stutz, R., 2, Pembroke-cottages, Edwardes-square, W.
Sutton, F. Stanley, F.S.I., 95 Cannon-street, E.C.
Sutton, Mark, 130A, Rua Braao de Mesquita, Rio de Janeiro, Brazil, South America.
Talbot, Ernest, A.M.I.Mech.E., Adams Manufacturing Company, Limited, Elstow-road, Bedford.
Taylor, W. H., South African College School, Oak-avenue, Cape Town, South Africa.
Thein, Maung Ba., Common Room, Lincoln's-inn, W.C.
Thomas, William George, 39, The Chase, Clapham-common, S.W.
Twite, Reginald C. N., A.I.M.M., Tionet, Caucasus, South Russia.
van Duzen, Harlan Page, 232, Great Portland-street, W.
von Leonhardt, F., 62A, Lombard-street, E.C.
Wade, William Edwin, Birchcroft, Racecourse-road, Tientsin, North China.
Wagner, Henry R., American Smelting and Refining Company, 120, Bishopsgate-street Within, E.C
Walford, Ambrose B., 219, Gloucester-terrace, Hyde-park, W.
Webb, Sir Aston, R.A., 19, Queen Anne's-gate, Westminster, S.W.
Whitehouse, Commander Benjamin, R.N., care of D.S.M., Port Florence, Uganda Railway, British East Africa.
Whitelaw, George James, 111, Thurleigh-road, Nightingale-lane, S.W.
Whiteside, Benjamin, 49, Adelaide-road, West Ealing, W.
Wilkins, Henry H. J., St. Tydfil-chambers, Queen-street, Cardiff

Winship, Thomas, F.S.A.A., 23-25, Mutual-buildings (P.O. Box 406), Durban, Natal, South Africa.

Wright, Alexander, care of Messrs. John Swire and Sons, 8, Billiter-square, E.C., and Shanghai, China.

Wright, R. A., Ijeun-house, Wesley-street, Lagos, West Africa.

Wunderlich, Adolph, Cuyahoga, Mayfield-road Sanderstead, Surrey.

Yeo, Henry Franklyn, Russell-house, York-street, Plymouth.

The paper read was—

THE BRITISH ASSOCIATION IN SOUTH AFRICA.

By Sir William H. Preece, K.C.B., F.R.S.

I purpose in this paper to record the views impressed upon the minds of some of the 380 members of the British Association who journeyed to South Africa in the interests of science, during the past autumn. I alone am responsible for what is written, but much of what is said is the result of consultation and conversation with my hosts and fellow travellers. Many at home assume and assert that the excursion has been a "picnic." But a "picnic" is a pleasure party in which each member contributes some share of provision or entertainment for the whole. We contributed nothing of this nature, but we were fed, housed, and entertained with a hospitality that was lavish, unstinted, and most enjoyable. If we have learnt nothing else, we have learnt what a warm-hearted and loyal race we have in South Africa, a race for which we have recently expended over 200 millions of money, and 25,000 lives, in order to maintain them in solidarity, security, and peace.

We have surveyed a country whose extent baffles all ideas of geographical distances impressed upon us by maps and railway journeys at home. Few people realise that the seat of the recent war covered a country as extensive as Germany, Holland, Belgium, and France combined. The railway from Cape Town through Kimberley, Bulawayo, and Salisbury to Beira is 2,037 miles. This is the same as the distance from London to Moscow. From Cape Town to Lourenzo Marques is further than from London to Constantinople. Many of us travelled 20,000 miles, while few did less than 17,000 miles.

Geographically and geologically the country is unique and instructive. Travelling is a great object-lesson in geography to those who go down to the sea in ships. It is a pity that the lesson is deferred so late in life. Travelling ought to be in the curriculum of education. We now know something of South Africa. We knew little about it before we went there. No one can appreciate a new country without some elementary geological information. Gold, diamonds, graphite, coal, lead, iron, manganese, copper, tin, are in South Africa in profusion. Their origin, diffusion, winning, trade value, and labour-employing functions are the attractive forces which have congregated the professional and commercial classes in great centres. It is surprising how a little scientific knowledge opens the mind to the value of even the rubbish heap, and I venture to hope that we have left behind us much of the seed of science. It has certainly fallen on receptive grounds and it must grow.

I need not dwell on the doings of the Association. They have been so fully reported by our home press that it is unnecessary. We left home at the end of July by the three steamers, *Kildonan Castle*, *Durham Castle*, and *Saxon*. We assembled at Cape Town and visited as a body Durban, Maritzburg, Johannesburg, Pretoria, Bloemfontein, Kimberley, Bulawayo, and the Victoria Falls. Some returned *viâ* Cape Town and others *viâ* Beira and the Red Sea, reaching home early in October. Excursions were made to every place of interest within reach. The scenes of historic battles and disasters were surveyed. We saw much of native life in war and peace dances, bridal gatherings, tribal meetings, compounds and "locations." At our sectional meetings we learnt much of their people of all races, of their system of transportation, of their industries and minerals, of their science and engineering, of their governments, their politics, their economics, and their educational systems. Speaking generally, I have come away with a very favourable impression of the potentiality of wealth and strength in the country. Though the reaction of the war has depressed trade, I can see strong indications of coming prosperity and powerful evidences of growing activity and energy. But there clearly exist resistances that have to be removed, fallacies that have to be exploded, and forces that tend to set up counter irritations, unless directed into beneficial channels by knowledge, judgment, tact, and strong common sense.

Science is defined to be systematised and organised common sense. We went to South

Africa to disseminate among the 1,750 who joined us there the principles of science. The press aided us by admirable reporting, and I venture to think that if no other work done justifies fructification, the dozen presidential addresses prepared and delivered by our twelve picked men in their several sections are of such paramount value, and contain such admirable matter, that they alone would form a permanent monument of our trans-oceanic southern expedition. I have not yet heard that they are to be separately published, as they deserve to be.

I.—The Country.

Africa is practically divided into two parts by the Sahara Desert, and these are virtually connected for inland transport purposes by the Valley of the Nile. It was along this route that early man must have marched to populate the Dark Continent. There are four great rivers in this land of over 11,000,000 square miles—Nile, Congo, Niger, and Zambesi. All the country south of the Zambesi is called South Africa. It has no real navigable river. The Orange River, with its tributary, the Vaal, flows into the Atlantic, and the Limpopo, the only other respectable river, discharges into the Indian Ocean. All other so-called rivers are only worthy the name after rains, and most of them dry up in summer. They are subject to sudden freshets, transforming them into something more than swollen torrents, which render fords impassable and disturb transport very much. They are not much used for irrigation purposes, but it is hoped that the admirable address of Sir John Scott-Moncrieff to the Engineering Section will call attention to the simple though costly mode by which they can be used economically. Unlike Great Britain, South Africa has distinct wet and dry seasons. It is swept by the warm Mozambique ocean current on the east side, and by the cold South-Atlantic current on the west side. The water in False Bay, on one side of the Cape Town peninsula, is always 10° to 12° F. warmer than the water in Table Bay. The mean temperature of Cape Town is 62° F., of Durban 72°·4, although there are only 3° of latitude between them. Agulhas Bay is the dividing line between the Atlantic and Indian Oceans. It is at the end of the warm current from the equator, and it is one of the most abundant fishing grounds in the world.

It is a remarkable fact that famine in India, drought in South Africa, and a low Nile, all follow the vagaries of the Indian Ocean monsoons. Some central heat disturbances in the south of the Indian Ocean affect the humidity of the air, so that barometric depression, variation of temperature, and cyclonic circulation vary the condensation of moisture and rainfall on the east side of South Africa, from the Zambesi to the Cape. These produce south-east storms and *summer rains* of great intensity. On the other hand, similar disturbances in the South Atlantic produce south-westerly storms and *winter rains* of less intensity on the south-west side of Cape Colony. These climatic disturbances produce great atmospheric electrical developments. Thunder, lightning and other electrical disturbances, including destructive hailstorms, are prolific and widespread in South Africa.

The mountainous character of the country and its ascent in great plateaux, or steps, to the Transvaal also influence climatic conditions. The plateau on the sea coast, near Cape Town, is about 50 feet above sea level, but about 30 miles inland it reaches 1,200 feet (Southern Karoo), about 65 miles inland 2,500 feet (Central Karoo), 150 miles inland, 4,000 feet (Northern Karoo), and in the Transvaal, 6,000 feet. The barometer which at Cape Town averages 30 inches, in Johannesburg runs down to 24 inches. The mean relative humidity in Cape Town is 79 per cent. of saturation, but in Johannesburg it is only 12 per cent. The mean annual rainfall in Cape Town is 38·24 inches, while in the Transvaal it is 29·68, while on the West Coast it is only 9·91 inches. These great changes of pressure, temperature, and dryness of air are very trying at first to weak constitutions.

Johannesburg suffers from a perfect plague of dust. Fogs of fine dry impalpable dust fill the air you breathe, clog the lungs, and irritate every mucous membrane. Attempts have been made to lay this dust, with quack expedients, but with no success. They must seek the cause, and remove or smother that.

II.—The People.

It is quite clear that the aborigines of South Africa were the Bushmen, for their implements, and weapons of a similar type to those used by them in modern days, are found buried deep in sedimentary deposits and in undisturbed strata. They were a diminutive race, with remarkably small hands and feet, and as wild as the gipsy in their love of freedom. They were mere hunters, and have been ousted from their lands by stronger races and practically exterminated, but specimens of them

may still be found, uncivilised. They were fond of music, dancing, and art, and their drawings in caves and sculpture on rocks are still visible. Their language was full of clicks and grunts, and one listens in vain for a vowel sound. It was probably from the Bushman—through the Hottentot — that the Bantu acquired his clicks.

The Hottentots followed the Bushmen. The Dutch found them in the seventeenth century in fresh occupation of the Western Province of the Cape country, but held back by the Bushman with his poisoned arrow, and themselves pressed on their Eastern side by the Kaffir. In all cases there is strong evidence that the coloured races descended from the North. The white race alone, apparently, entered South Africa from the sea. The Hottentot, in his turn, and in comparatively modern days, succumbed to the Bantu — a northern race with a strong Negro element, whose language bears acquired the clicks which originated with the Bushman, but the later and more martial tribes, never having come in contact with the Hottentot, have no clicks. They brought with them other gutturals, and the Ll sound which has been traced in Sardinia and in Spain. In the "Kitchen Kaffir," so much spoken by the mixed "Cape boy" domestic servant, and so easily acquired by Europeans, I detected neither click nor "Ll" sound.

The Dutch seized the Cape in 1652 and the British in 1795. It has belonged to Britons since 1806. The Dutch and English languages predominate, but the Dutch is a dialect called the "Taal." It has a strong admixture of Bantu words, while the colonial English is full of Dutch words. Most residents, except in Natal, must be bilingual, and many are trilingual.

The Afrikander is a very mixed population. A census was taken in 1904. I have summarised it in the following table :—

	Whites.	Asiatic.	Hottentot.	Fingoes.	Bantu.	Mixed.	Total.
Cape	579,741	15,682	91,260	310,720	1,114,067	298,334	2,409,804
Natal	97,109	100,918	..	..	904,041	6,686	1,108,754
Transvaal ...	300,255	23,946	..	..	1,030,029	..	1,354,230
Orange River .	143,419	..	..	..	241,626	..	385,045
Rhodesia	12,623	..	..	..	593,141	..	605,764
Bechuanaland .	1,004	..	..	..	119,772	..	120,776
Basutoland ..	895	..	..	..	347,953	..	348,848
Swaziland	..	..	..	..	..	..	..
	1,135,046	140,546	91,260	310,720	4,350,629	305,020	6,333,221

Whites	..	..	..	..	1,135,046
Coloured	..	..	..	..	5,198,175
Grand Total		..	..	..	6,333,221

traces of Semitic origin. In one of its finest tribes—the Zulu—it possesses a magnificent physique, splendid bravery, and great military instincts. I was surprised to find that the Zulu possesses in a very marked form the peculiar sound confined in Europe to the Welsh language, transliterated by "Ll" in Welsh and "Hl" in Zulu. The hill Hlangwani, which General Buller did not occupy near Colenso, could be written Llangwani and pronounced as a Welsh word. A Zulu would have no difficulty in pronouncing Llanfairpwllgwyngyll.

When the great Bantu invasion from the North descended on South Africa, the various tribes mixed much with the Hottentots, and

It thus shows that the proportion of coloured people to white is about 5 to 1, but it will be noted that the coloured races are much divided. The number of Asiatics is startling. We were much surprised to see so many fellow subjects from India. They are found all over the Colonies, as waiters, servants, small tradesmen, gardeners, agricultural labourers, &c. The Malays are principally coachmen and cab-drivers. The 46,000 Chinese, now there, were not included in the Census. Added, they would show nearly 200,000 Asiatics now in South Africa. The numerous Bantu race is divided into separate and independent tribes :—The Zulu, Matabele, Swazi, Bechuanaland, Basuto, Fingoes, and other Kaffir tribes, without cohesion

or co-operation, or even identity of language. Hence the disparity in numbers is no sign of weakness, for the whites are, or should be, connected and combined by government, religion, trade, and military organisation, into one constituent controlling class. It is the duty of every Government, Imperial as well as Colonial, to facilitate in every way this self-defensive co-operation. The colonies of South Africa are now making history. Politicians at home should leave them alone. They resent very much the inclusion of their carefully considered re-constructive doings in the ignorant hustings vituperations of political parties.

South Africa is very mountainous, but the peaks are not very high. They vary from 12,000 feet to 7,000 feet. The best known is the Drakensberg Range, which divides Basutoland from Natal, and Natal from the Orange River Colony, and which we passed on entering the Transvaal at Laing's Nek. The most beautiful is, perhaps, the Hottentot Hollands Range, that made such an exquisite background to the unparalleled scene as we entered Table Bay at sunrise, while the most celebrated is the Table Mountain, that towers over the sea entrance to Cape Colony. Table Mountain terminates the Peninsular Range, with its "Twelve Apostles'" peaks, one of the most beautiful spots on the face of the earth, especially when clothed, as we saw it, with its early spring carpet of Cape wild flowers, which are conservatory prizes with us.

Steaming from Cape Town to Durban we skirt the ranges of the Langeberg, Onteniqua and Amatola mountains before striking the Drakensberg, which forms for nearly the whole way to Durban, a beautiful background of very varying scenery, brightened up at night by great fires—the primitive mode by which the farmer clears his land for his next season's crop.

III. The Government.

There are five distinct colonies in South Africa, each under separate and independent control.

1. Cape Colony, 2. Natal (with responsible government); 3. Rhodesia (the British South Africa Company, under Royal Charter); 4. The Transvaal, 5. The Orange River Colony.

There are also two Protectorates—

6. Bechuanaland: 7. Basutoland.

Each Colony is presided over by a Governor and each Protectorate by a Resident Commissioner, all acting under a High Commissioner, an office at present held by Lord Selborne.

A *Responsible Government* is one in which the Home Government has no control over any public officer, but the Crown appoints the governor and retains a veto on legislation.

A *Crown Colony* and a protectorate are entirely under the control of the Home Government.

It is quite evident that while matters in the Colonies are in a state of transition and every public man is occupied in working out the best possible system to secure political stability, it would ill become those who went out to teach to come away and criticise the immature solution of imperfectly-learnt problems. Politics, therefore, I lay on one side. They are receiving the most careful consideration of our rulers, and the worst possible handling by our anonymous and irresponsible censors. There are, however, serious questions of *Education*, *Economics*, and *Labour*, which were carefully examined and discussed at our meetings.

IV.—Education.

This section was presided over by Sir Richard Jebb. His address was a model of literary polish and refined manipulation, and from an academic point of view it was unsurpassable, but from the technical point of view there was room for information.

Excellent papers on the colonial systems were read by Rev. W. E. C. Clarke, Mr. Hugh Gunn, Mr. J. H. Corbett, Mr. Hope, and Mr. Sargant.

The Orange River Colony is well advanced, and the settlement of the religious difficulty is worthy of deep attention. The administration is centralised. Mr. Hugh Gunn is the Director of the Department of Education. The colony is divided into school districts, each under the control of a committee. The districts are conterminous with the magisterial areas, not dissimilar to our counties. A majority of the committee is elected by the voters of the district, and the remainder nominated by the Governor. Education is free and compulsory. There were 258 schools in June last, with an average attendance of 60. The number has increased rapidly since, owing to the growth of buildings and the supply of teachers, of which there was a dearth. The predominant church is the Dutch Reformed. A conference was held in June last, where, in addition to the above body, the Anglican, Roman Catholic, Presbyterian, Wesleyan, Lutheran, and Hebrew churches were represented. It was decided—

1. Schools should be opened with the Lord's prayer and by the teaching of Bible history before or after the secular work of the school.

2. For an hour on one day in each week ministers should have the right, at the request of parents, to use the school premises to give definite dogmatic instruction to the children of their own faith immediately after the secular work.

3. There is a conscience clause enabling parents to withdraw their children during the time set apart for Bible history.

4. Teachers who declare that they cannot conscientiously teach Bible history are exempted from giving instruction in that subject.

The effect of this agreement has been a uniform system throughout the Colony, and, so far as can be judged at present, the settlement of the religious difficulty question.

It is a pity that there should not be a unification of all the educational forces throughout South Africa, and the introduction of a similar system elsewhere. It would be a great object-lesson for the Mother Country, where denominationa interference is resented very seriously, as we know in Wales. It would facilitate the supply of trained and desirable teachers—the great want of the present day in the Colonies.

The language question in South Africa is a very difficult one. They have to deal not only with Dutch and English, but with the native Bantu and the different Oriental languages through the large Asiatic element in the country. Mr. Hope says :—"There are many cases where a boy hears German or Yiddish spoken by his parents ; in the kitchen he hears Kaffir, in the street, Dutch ; and in the school, English." We have at home a somewhat similar condition—in Wales—but there it is only bilingual. It is quite clear that to teach a child properly, you must exercise him in the language with which he thinks, and this is the language he acquires on his mother's lap. Hence you must first teach him in his native tongue, and therefore the elementary teacher must be bilingual. When, however, he has acquired such a knowledge of English that he can speak and think in that language, the necessity for bilingual instruction in secondary and higher education is not so peremptory. The position in Wales is simple: you are dealing with two cultured languages. It is not so in South Africa: you are dealing with a barbaric "lingua franca," as well as about thirty uncultured tongues. Mr. Hope says :—"The difficulty is that of teaching the power of cultured language to those who have none."

The tendency of all education in the past at home has been to instil "culture" into the minds of the young, now the tendency is to encourage "action." The one is purely mental ; the other is mental and physical. Hence in all systems of higher education, technical matters are much to the front. Technical education means training the mind so that it may assist the hand. The craftsman, if he have scientific method of thought, knows the reason-why of every motion and the use of every tool. The engineer understands not only the mode of producing energy by chemical operations, but he designs the applications of this energy to innumerable useful purposes by utilising air, water, steam, gas, or electricity. We have great object-lessons in America and Germany in proving to us the value of encouraging technical attainments, and it is a matter of great satisfaction to find much progress at home and certainly considerable activity in South Africa which cannot fail to be encouraged by our visit there.

A first-class Technical Institute on the most modern lines has been established in Johannesburg, and it has a brilliant future before it.

There is no teaching university in South Africa. The Cape University was incorporated in 1873, and received a Royal Charter in 1877. It is an examining body granting degrees like the late London University.

Agricultural science is much needed in South Africa. The farmers desire it, and warmly support it. Clearing the veldt by fire is utterly condemned by our agricultural members. Forestry is even more desirable. Only $2\frac{1}{2}$ per cent. of the area is under true cultivation. One million pounds worth of wood is imported per annum. There is no doubt that forests mitigate atmospheric electrical effects, and they also improve the rainfall.

V.—Missions.

Arising out of the question of education is that of mission work, which has always been the pioneer of education. There are thirty-two distinct and separate missionary societies at work in South Africa. It is a pity that missionaries have not contented themselves with the educational function of their duties. To teach the savage to read and to write, to show him how to cook, and to make tools, and how to use them. To teach him to think, and to place in his hands the Bible, the finest food for thought that man ever compiled, to help him to

understand it, and to train him to deduce his own conclusions from it, all this is worthy of a civilised man and a Christian. But to interfere with the autonomy of tribes, to sow discord between stations and peoples, to try and thrust polemical dogmas into the unprepared hypercritical mind of the heathen, to display to the untutored native the lamentable discord and differences of Christians themselves, to descend to the petty meannesses of trade, and to send home misleading reports, is to bring the character of the missionary and his work into discredit and dispute. I regret to say that while there are many noble examples of splendid workers and immortal martyrs, the general conclusion formed is that missionary work is a failure when it extends itself beyond the mere educational stage. Although the Bantu language is very rich, the native brain is not sufficiently developed to grasp spiritual doctrines. Converts are numerous, but several housekeepers told me that they forbade native Christians from entering their houses; on the other hand, I heard of many faithful Cape boys and converted Zulus. There is no gainsaying the fact that good practical work has been done—apart from the purely religious aspect—by missions in South Africa. No one who has seen some of the native products of Lovedale turned out under the administration of Dr. James Stewart could question this for a moment.

Khama, the Bechuana chief, was a fine example of what can be done with an exceptionally trained mind. "He was a man of extraordinary dignity of character, with a strong grasp of Christian morality and profound loyalty to his God" (Home). He stamped out drink. He said:—"I fear Lobengula less than I fear brandy. I fought against Lobengula and drove him back. He never gives me a sleepless night. But to fight against drink is to fight against demons and not men. I fear the white man's drink more than the assegais of the Matabele, which kill men's bodies. Drink puts devils into men and destroys their souls and bodies." (Parsons.)

There are two practices in vogue among the Bantu race that seem to demand the serious attention of the statesman. They are polygamy and lobolo.

Polygamy is at the root of the idleness of the native. His wives are his slaves. They do all his labour, supply all his wants, and he is able to lead a life of luxurious indolence.

Lobolo is the price he pays for his wives. Khama abolished among the Bamangwatos the purchase of wives by cattle and introduced a law of marriage by free choice. It has not extended to other tribes and I cannot tell whether the Bamangwatos follow the practice now that Khama is no more. Christianity abolishes polygamy. We cannot evangelise a nation by legislation, but we can abolish polygamy by that means. Now that inter-tribal wars have ceased the growth of the Bantu race is much increased. The abolition of polygamy would check this growth.

VI.—Labour.

This is the knottiest point in South Africa. It is a question of air pressure, temperature, and race. It is not a question of white labour at all. The white man may or may not be able to work in South Africa. That is not the question at issue. The question at issue is, is it politic or wise to place the white man and the virtual coloured barbarian shoulder to shoulder to do the same work and earn the same wage? The paramount importance of this issue was decided by the war. Great Britain might have let loose nearly the whole Bantu race upon the Transvaal and terminated the war in half the time, and at half the cost. But it was made a fight to the finish between white and white. The white man remains the paramount race. The Bantu, whatever his nation, is not yet the equal of the white man. He is a magnificent animal, but he has not been trained to regular habits of work by the discipline of civilisation, or by the influence of example. A whole century of unstinted expenditure and unlimited voluntary noble service has not made him a Christian. He remains the splendid physical creature who must be subservient to his white master. He is a heathen and a polygamist. His sole object in working is to secure sufficient money to buy ten oxen, and with these oxen to buy a wife. He is not satisfied with one wife, he must have three, and then they become his slaves. He luxuriates in the *dolce far niente*, and dreams only of pillage, idleness, and sleep. Of course there are exceptions. There are exceptions to every rule, and it is the exception that proves the rule. In Jamaica, which I visited shortly before I went to South Africa, there are 15,000 whites and 750,000 coloured people, but every coloured person is a Christian and educated. In the United States of America it is the same. In South Africa the evangelised coloured person is lost in the great majority of heathens and laggards.

Many of the mines on the Rand were shut down and idle for want of coloured labour.

The Zulu was suffering from swelled head and opulence. The Chinaman, an educated, industrious, and skilled artisan, was available. Careful consideration was given to his employment. The local and home Governments were consulted and approved the proposition. The effect has been magical. All the mines have been opened. The output of gold has beaten the record. This one gold-producing area—the Rand—has supplied one-fourth of the gold output of the world, and the returns for this year will exceed those of last.

The Chinese compound is a roomy, open space, enclosed generally by corrugated iron buildings, but frequently by well-built more permanent dwellings. Their cubicles are well furnished. They are decorated with coloured materials and photographs. They are supplied with eiderdown quilts. They have baths with hot and cold water. The Chinese are to be seen wandering about perfectly unconcerned and apparently very happy. Not a vestige of anything approaching slavery is evident, either among the Chinese or any other coloured people, in South Africa.

The following is a translation of the notice put up in Chinese in the compounds :—

"Labourers are hereby warned that the law forbids them to leave the mine on which they are employed without first obtaining leave and a proper leave permit from the compound manager. No permit allows labourers to proceed outside the Witwatersrand district.

"There are two kinds of leave permits; one is a red one, available only for the day on which it is issued till sunset, when the labourer must be back in the compound. The other is a white permit, and is for leave not exceeding 48 hours, and will only be granted in exceptional cases. Any labourer who has permission to leave the mine must always take his permit and his Government metal passport with him, otherwise he is liable to be arrested by the police. The use of any permit after the time of its expiry will render the labourer liable to arrest by the police.

"Every Sunday morning a parade will be held in the compound at or before 10 o'clock on all mines, at which all labourers must be present, except those who are at work, or have received permission to be absent.

"Labourers will no longer be able to travel by railway unless they have a leave permit and their Government metal passport, and the railway officials will no longer issue tickets without seeing a labourer's permit. No railway ticket will be issued to a labourer to any station outside the Witwatersrand district. Labourers must have their leave permits stamped at the booking office."

The natives in Natal seem more settled and contented than in the other colonies. There is a large farm, 24,000 acres in extent, within twelve miles of Maritzburg, fitted up with up-to-date machinery :—mechanical, centrifugal, and electrical. It is thoroughly well irrigated and it is cultivated by educated native labour. The educated native who has passed through some of the schools to which I have referred, where labour is kept well to the front, can by care and paternal control be made a valuable labourer. These men rarely leave the farmer, and they give him a very satisfactory service. He was asked, "Now instead of employing all these coloured people (100 Kafirs and 100 Indians) could you not employ white people ?" "Yes," said he, "but no thank you, I'd rather not take on the worry. My people are happy and contented, but white men would not be. They would be constantly agitating, and I should be worried with all and more of the English labour trouble."

In *locations* the natives live together in tribunal communities and under governmental control. They are quite free, but every native has to carry his "permit." It is like a sailor's warrant or a traveller's passport. No one can engage a native for any occupation without inspecting his "permit," and it must be endorsed by the employer on leaving his appointment. If a native is found without his "permit," he is arrested and handed over to the police. If he cannot give a good account of himself, he is returned to his tribe or his location.

VII.—Economics.

The cost of living in South Africa is abnormally high. An admirable paper on this subject by Mr. Alexander Aiken was read, and well discussed, at Johannesburg. It is startling to find that a skilled white working man earns £1 per day, and that he has difficulty in meeting all his wants on this splendid wage. We can apportion the usual expenditure of a household into necessaries and luxuries : —*Necessaries.*— Rent, food, clothing, heat, light, health, education, religion, maintenance, insurance. *Luxuries.*—Reading, entertainment, travelling, tobacco, wine, spirits and beer, charity, thrift, art. In South Africa, cost of transport in the interior weighs heavily, and agricultural cultivation seems backward. There are no evident market gardens, and the farms are very large, and out of the reach of cheap transport.

By far the most expensive item of expenditure is rent, and this re-acts on nearly every other item. Of course, it is mainly controlled

by the question of supply and demand, but the security of tenure under political disturbances has been hitherto the chief factor in the Transvaal. Rent depends on the estimated number of years of purchase of a building erected for investment. In Great Britain, where security of tenure is absolute, landlords are satisfied with twenty-five years' purchase, which secures a return of 4 per cent. In Johannesburg the standard hitherto has been six years' purchase, securing a return of 16½ per cent. Thus, a house which fetches £20 a year in Great Britain fetches £85 a year in Johannesburg. But the cost of building in the Transvaal is much greater. So much material has to be imported or carried by sea and land, and the freight is a very serious item. In fact, I met there a young Post Office official, the son of an old telegraph friend in England, who had retired from the service on pension, who was paying £120 a year for a house which had no more accommodation than his father's house in the suburbs of York, for which only £19 a year was being paid!

The uncertainty or ignorance of the duration of the gold supply may also be another factor. Land, too, is scarce, the demand for it great, and the price very high. But all is changing. The security of British occupation, the estimated value of the gold output, the discovery of new mineral deposits, and the certainty of cheaper transit, especially in municipal areas, will reduce rents and *pari passu* the necessaries and luxuries of living. Even now the thrifty man secures benefit by building his own house if he can command the capital, and the master aids his labour by building workmen's dwellings. The Central South African Railway administration has done this to a large extent and thereby has secured a lien upon their men which makes for discipline, faithful and long service. This also is at the root of the extremely efficient compound system applied to coloured labour.

It must be remembered that in South Africa there are no navigable rivers and no roads worthy of the name. The railway is virtually the only means of transport. Freights on sea and railway are heavy, and therefore all important material for food, clothing and luxury, is much enhanced in price.

VIII.—The Railway System.

Before discussing the railway system I must point out that one very important factor in determining this question of cost of transport is cost of government. There is a science of taxation and business. There are laws developed by the ordinary events of humanity, collected in numbers as a nation, to render living healthy, happy and secure. Government, in one form or another, is absolutely essential, and must be paid for. How can it be paid for so that every human unit in the nation shall bear its fair *pro rata* burden? How are ways and means to be provided so that the military, naval, and civil services of a country are to be met? There must be taxation, and the incidence of this taxation should be fairly distributed upon all classes. This is purely a business affair, and should be considered as a commercial matter. It is called the fiscal system of a country. South Africa is peculiar in this that the coloured population bears to the white population the ratio of 5 to 1. The small minority is the sole wealth-producing class, and the large and idle majority reaps the benefit of security, peace, and safety. The problem is how to make the native contribute fairly to the funds at the disposal of the governing powers. His food demands are small, his clothing is insignificant, he indulges in few luxuries, but he is very fond of travelling. Direct taxation like the hut tax is an eternal source of trouble. Indirect taxation like a railway fare is unfelt. Hence the apportionment of a portion of the receipts of Colonial traffic to meet the enormous expenditure required for Government is fair and just.

The different colonies derive a considerable revenue from railway receipts. In 1904 the Central South African Railway handed to the public revenue of the two Crown colonies £831,668. It is another mode of taxation. How far it is just it is difficult to say, for while on the one hand every passenger pays his share, on the other hand freightage of goods must fall unequally on supplier and user.

Mr. Aiken mentions the case of the importation of some Oregon pine. The wood cost, free on board £1,921, freight by sea £3,281, freight by railway, from Lourenzo Marques to Johannesburg, £6,046, making the total cost of the wood, £12,663. We see here one reason why building is so costly in the Transvaal.

The railway system of South Africa is divided into several sections, colonial and intercolonial.*

* I am much indebted to Mr. A. M. Tippet's exhaustive paper on "Cape Government Railways," read at Cape Town, before the Engineering Section, for information.

A.—In Cape Colony there are—

1. The western system from Cape Town to Vryburg, including a good local suburban system about Cape Town.

2. The midland system from De Aar junction to Port Elizabeth, joining the Western system at De Aar junction.

3. The eastern system from East London to Bethulie, Lady Grey and Elliot in Kaffraria, joining the midland system at Cookhouse junction and Rosmead junction, and the Orange River section at Bethulie.

B.—In Natal we have—

1. A coast line from Port Shepstone through Durban to Somkete.

2. A main line from Durban through Pietermaritzburg and Ladysmith to the Transvaal at Harrismith and Charlestown.

C.—In the Orange Free River—

A main line from the Orange River, where it connects with the Cape midland system through Bloemonfontein entering the Transvaal at Vereeniging.

D.—In the Transvaal—

1. From Vereeniging, through Johannesburg and Pretoria, to Komati Poort, where it joins the Portuguese line to Lourenzo Marques.

2. A branch from Johannesburg to Klerksdorp.

3. A branch to Pietersburg from Pretoria.

4. Another to Charlestown, joining the Natal main line.

5. Another from Germiston to Springs, serving the Witwatersrand.

E.—The Rhodesian Railway—

1. From Vryburg to Buluwayo.

2. From Buluwayo to Victoria Falls.

3. From Buluwayo to Beira, with branches to West Nicholson and to Alaska.

The gauge of all these lines is 3 ft. 6 in. But there is a 2 ft. gauge line from Port Elizabeth to Avontour, 170 miles long, only partially open, and from Kalabar Kraal to Hopefield, 47 miles long.

Taking Johannesburg as a centre, the distances to the different seaports are :—

Cape Town	1,007 miles
Port Elizabeth	714 „
East London	665 „
Durban	483 „
Lourenzo Marques	396 „

It is clear that if rates for freight are based on mileage it must be cheaper to send them *viâ* Lourenzo Marques than *viâ* Durban. I noticed that all the heavy machinery at the Diamond Mine and on the Rand had come by the shortest route. Freightage is a very important item in the economy of a railway system. All railways which serve the Transvaal suffer from the peculiarity that all the heavy traffic flows one way only. Of the total receipts of the Central South African Railway three-fourths are for goods and only one-fourth for passengers. By the Cape Railway the proportion is more nearly one-third and two-thirds.

The railways centreing on Pretoria and Johannesburg, including the Orange River and Transvaal system, are combined into one system, called the Central South African Railway, with headquarters at Johannesburg. Special carriages are allotted to natives.

The speed of travelling averages about 20 miles an hour, and the safety is very sure indeed. The carriages are very comfortable and the four special trains made up of sleeping and restaurant cars, which took the British Association from Durban to Beira, and in which we travelled and lived for many days, were all that one could desire.

The lines are extremely well built and well equipped, and though they may not compare with the London and North-Western Railway, they do so very favourably with those in other colonies. The two-foot gauge is a bold experiment, and it is an experiment that will be carefully watched. The traffic of these light lines is chiefly agricultural produce. Hence speed is scarcely a factor in the case, but it is bulky and the narrower the gauge the less its capacity for carrying such traffic.

The marked features of the railway as a whole are their wonderful ascents, their surface character, the absence of tunnels and earthworks, and their serpentine meanderings. They cut at a small angle the contour lines of the hills. The ascent (16½ miles) up the Hex River Pass is the most beautiful and interesting railway I know. The ruling gradient is 1 in 40, the sharpest curve 330 feet radius. Its summit is 3,193 feet above sea level. A very similar ascent equally well carried out is that from Pietermaritzburg towards the Mooi River.

The lines are all single, worked on the block system, with a well-designed telegraphic system to change the crossing places of trains meeting in the event of delay. Between De Aar Junction and Cape Town—501 miles—we passed 120 trains. There are innumeral crossing sidings to facilitate this.

The general manager of the colonial rail-

way has not the free hand of a general manager at home. He is subject to Parliamentary control. Mr. Tippet said:—"There can be little doubt but that the trace of the political hand is evident over the railway map of South Africa, and in the opinion of many, not always to the best interests of the country as a whole."

Harbours.—Mr. C. W. Methven read an excellent paper on South African harbours. There are no natural harbours between Cape Town and Delagoa Bay, and all existing harbours have been artificially constructed at great cost. The engineer has triumphed over the raging sea and the formation of bars. East London, Port Elizabeth, and Durban are illustrations of turning Nature against herself. Dredging and controlling the proper direction of currents have compensated South Africa for the absence of deep water protected bays.

IX.—Industries.

The principal industries of South Africa are farming, the extraction of gold, the production of diamonds, and the winning of coal; the development of iron, manganese, copper, tin, graphite, and various other minerals undoubtedly remain for the wonder of our children.

Farming.—Farming as an industry in South Africa is practically pastoral, the rearing of cattle, sheep, and ostriches. The country was virtually denuded of cattle by drought, pestilence, and war. At the present time large quantities of frozen beef and mutton have to be imported from the Argentine and Australian colonies to feed the population, and years must elapse before in this respect South Africa becomes self-supporting. Nor can the country, with the examples of Canada and the Argentine before us, be called an agricultural one. The absence of perennial rains is the drawback, and can be met only by afforesting the vast inland plains, or by extensive schemes of irrigation. For many years to come South Africa must depend upon its mining.

Gold.—The Witwatersrand collection of mines is the largest and most important single gold field in existence. The total production of this precious metal in the world was in 1904 £72,323,064. Of this the Transvaal supplied £16,277,235, nearly a quarter. The output for 1905 will be greater. It will probably exceed £20,000,000. This wealth, unfortunately, does not remain in the country. The millionaire does not live in Johannesburg. He is found in London, Paris, Berlin, and New York. Ten per cent. remains in the country as a contribution to the Government revenue. The portion expended in management and labour also remains, but the lion's share is exported from the country.

Granite is the base of the gold-bearing strata. *Banket*—so called from its similarity to a Boer cake of the same name—is the out-crop of this—forming the Rand. Banket is a sedimentary bed of sand and clay forming layers of gold-bearing conglomerates containing apparently water-worn pebbles embedded in a cement impregnated with gold and iron. At some early period in the world's history, a vast volcanic upheaval formed the ridge or Rand, moulded of molten igneous rock. The layers of this banket were tilted at different angles, generally from 26° to 30°. This out-crop extends for nearly 80 miles, and its counterpart must exist somewhere to be discovered. These beds contain reefs or seams of gold-bearing strata. The main reef leader is the richest source of gold, it contain 10 ozs. per ton. The main reef itself contains 1 oz. 15 dwts. per ton. The mean yield per ton is, over the whole output, 9·37 dwts. In early days, gold was obtained entirely from alluvial deposits by washing, and in many places it is found in large masses, called "nuggets." The peculiarity of this gold-bearing ore on the Rand is that the metal is invisible. It is not found in nuggets, or even in visible particles. It was probably solidified with its matrix when it was in a molecular condition. The ore is mined or won in galleries at various depths down to 3,000 feet. It is sent to the surface broken up, and there sorted mechanically by screens into three classes. From this, by expert visual inspection, "waste" or valueless stuff (barren rock) is thrown out. The selected ore is then crushed into smaller fragments, about the size of walnuts, and then passed to the mill to be crushed to fine powder by stamps in steel mortar boxes, each stamp weighing about 1,000 lbs. Tube mills, a recent improvement by which the pulp is reduced by a secondary grinding action to an impalpable liquid, have increased the efficiency of milling very largely. The noise of a mill is deafening. The pulverised ore is mixed with mercury and water into a kind of cream, which is driven or washed through extremely fine wire meshes falling over inclined copper plates or tables coated with mercury. The mercury amalgamates with the gold forming a kind of mud, which ad-

heres to the mortar boxes and copper plates. It is scraped off the tables and passed into crucibles. The gold and mercury are then separated by heat, the mercury vaporising away and condensing by cold for further use. This process of amalgamation secures 65 per cent. of the gold.

The powdered ore, or battery pulp, is "concentrated" by pulsating machines (free-vanners), and divided into concentrates (the heaviest parts), sands, and slimes. These "tailings" are mixed with cyanide of potassium as a solvent, forming a double cyanide of gold and potassium, and are led into "precipitation boxes," where zinc in very fine strips or shavings is brought into contact with the liquid, and replaces the gold. Thus by chemical affinity the remainder of the gold left by the amalgamation process is freed from the cyanide. The gold is also sometimes thrown down by electro deposition. The zinc is freed from the cyanide of potassium by diluted sulphuric acid, and only about 1½ per cent. of the metal is lost. The "tailings," or refuse, is fine quartz or silica sand, very white, and forms at every mine a great mound of fine dust, which, in high winds, combines with the fine dust of Johannesburg and adds to its discomfort, and perhaps danger.

The course of the different reefs has been determined by boring. It has been assumed that these bore-holes have taken a true plumb line, but experience has lately shown that this is not true. The bore pipe or rod when jointed up is elastic and flexible, and as it enters strata of different degrees of density and hardness it is diverted out of the plumb line. It is a kind of mechanical refraction. The rod is usually about 1½ inch diameter and screwed up in lengths of about 20 feet. This deviation is of little consequence when the boring operations are properly surveyed and the curvatures measured, as they can be, during the course of boring. Moreover, it can be checked by temperature observations. The rise of temperature has been found in the Rand to be 1° per 208 ft. by Mr. Hugh Marriott, who has designed a mode of determining the deviation of a bore. Mr. Payne-Gallwey has also designed a very beautiful machine, and Mr. Hatch has worked at the question. It is, however, quite certain that many early bore-holes have given false measurements as to the depth that different reefs have been struck.

Diamonds.—The diamond is pure carbon in a crystalline form. It was made in the early prehistoric age when active volcanic action was prevalent. It is found in "pipes," which are vents in the earth's crust blown out by great pressure from below which probably discharged masses of molten matter with great force into the atmosphere, as occurred in Krakatoa in 1883. No trace of volcanic *débris* is now found around and about these pipes. This have been cleared away by denudation. The pipe is lined with a rim or lining of igneous rock of basaltic formation called "reef," and it is filled with "Blue-ground," a *breccia* containing shale, crystals, gems, and precious stones, especially the diamond. The diamond is a dull-looking mass of the appearance of gum or amber, and of every shape and size up to the great Cullinan diamond weighing 1¼ lbs., of inestimable value. It has to be cut to its proper form to become the precious and the lovely gem of fashion. There are two forms, the *brilliant* and the *rose*, the latter being the form of flat stones and the former of plumper ones. This diamond cutting is confined to Amsterdam and to Antwerp, where it has become a hereditary and very lucrative industry. The origin of the diamond is an excessively difficult scientific problem to solve. It was the subject of a great lecture by Sir William Crookes at Kimberley. The carbon was once in a gaseous state, and by changes of temperature, pressure, and time it was transformed into the crystal we know—the hardest known form of matter, and the priceless jewel of the Premier mine. There are many pipes or mines opened and unopened. I will confine myself to the Premier mine, near Pretoria, which I inspected with great care, under the guidance of Mr. Cullinan. The ground surface of the Premier pipe measures 77 acres. Its depth is unknown. From boreholes that have been made it seems to descend with fairly perpendicular sides, and the blue-ground maintains its character as far as they have gone. It is now worked as an open mine, but shafts and galleries will eventually be resorted to. This blue disintegrates or "weathers" when it is exposed to the air, and becomes yellow. It is easily crushed by gentle pressure, and the pebbles, minerals, crystals, garnets, and diamonds are easily washed and sifted out of it by machinery. The deposit is first inspected by white overseers, and all large stones picked out. It is then sorted by coloured labour, and the diamonds picked out, dropped into small boxes, collected and sent to Pretoria for valuation. The sorting is entirely de-

pendent on the eye and experience of the natives.

Up to the time of my visit 2,051,964 loads of ground had been treated. They yielded 1,511,931¼ carats of diamonds, or 0·736 carat per load. The total weight of diamonds obtained was 6 cwts. 19 lbs. One carat is equal to 3·17 grains, and a load equals 1,600 lbs.

It has been found that diamonds adhere to grease and to concentrated oil, and that they are unique in this. Sorting is now being done by this process in Kimberley, and it will also soon be in operation at the Premier Mine. This process is much more effective than ocular sorting, and it entirely eliminates stealing. It secures every diamond and supercedes the necessity for sizing. The use of water is much reduced. The diamonds will be automatically collected in a small centrifugal locked separator. The manager himself will, from time to time, remove the diamonds from the separator without their being handled by any one else, and will send them to Pretoria to be sorted and valued, where they are weighed in carats and sorted into parcels of equal weight. Each bundle is then re-sorted into (1) perfection of form; (2) colour; (3) defects (spots, lines, &c.); (4) use for gems, drills, paste, &c. They are then allotted their estimated market value. It requires great expert knowledge to do this. I witnessed the sorting and valuation of 70,000 carats of diamonds whose value was estimated at £90,000. South Africa is the largest diamond producer in the world; Brazil comes a poor second, and the third place is taken by Borneo and India. About £6,500,000 worth of diamonds are extracted annually from the mines in South Africa.

The Transvaal Government claims 60 per cent. of the allotted area as the property of the Government, leaving 40 per cent. to the owner or company working the mine. Thus the Government obtains, as taxation or revenue, 60 per cent. of the profits of the mine. It is a large slice. The Orange River Colony exact 50 per cent., but the Cape Colony have no such provision. The Kimberley mines pay only income tax.

Coal.—Coal is abundant in every colony in South Africa. In Natal alone there is more coal than there ever was in Great Britain. It is also of very fair quality though not equal to that of South Wales. The calorific capacity of Natal coal is 10 B.T.U, from one pound of coal, which though not equal to South Wales coal, compares favourably with many British coals. There are 56,000 square miles of coal country. The seams vary from 10 to 20 feet thick. Fire-damp is unknown. Vereeniging in the Transvaal has the best organised system of collieries.

Silver.—There is much silver in South Africa but it has received little atteution. Concentrated ore is shipped to Swansea.

Copper.—Copper is also abundant, especially in Rhodesia, as well as lead, plumbago (graphite), zinc, antimony, tin, quicksilver, &c.

Tin.—Tin has been discussed, and is now being vigorously exploited in the Bushveldt, not far from Pretoria.

Iron.—Iron is also abundant but it has not yet been worked. If manganese were found there, then with an inexhaustible supply of iron and coal, the introduction of the Bessemer steel process into South Africa would make a serious onslaught upon the American and British steel industry, and might react with great force on all other local industries in that country.

Oil.—There is some prospect of oil being found, for shale is abundant. Petroleum has been found at Ceres (Cape Colony), but no prospecting has yet taken place.

There are many industries to which I paid little or no intention, principally for want of time; for instance, manures, nitrates, fruit, tea, coffee, ostrich feathers, jam-making, &c.

Wine did attract my attention, for I passed through the vineyards of Constantia and Swart Koppie, and I tasted many admirable wines, especially Cabaret Savignon, which, if it could be sold in London in the same condition that it is in Cape Town, would attract a wide *clientèle*.

There are some excellent mineral waters. Riebeek is admirable, it is an excellent table water surpassing Rosbach or Apollinaris. It is quite pure and slightly diuretic. It is a staple drink with whiskey in Cape Town.

Very striking features of the country are the absence of visible boundaries between properties, the vast and numerous ant hills (signs of good cultivateable ground), the absence of game and the paucity of birds, especially the songsters. The Boknagerri is the only exception, and she is only a monotonous chirper—she does not sing.

We were much impressed with the "Cadet Corps" in which the Colonial boys are taught early the art of rifle shooting, and trained up to habits of physical training, discipline, and of military ways. This is the work that Lord Roberts has inaugurated at home. It is in full force in South Africa. The review of the Cadets in Durban was one of the prettiest sights we saw.

One sight gave us all a melancholy gratification. It was the loving care with which the graves, tombstones and memorials of those lost in the recent lamentable war are preserved and tended by the Guild of Loyal Women of South Africa.

Conclusion.

I regret that time and space are limited, and I must bring this long paper to an end. I have by no means exhausted my subject. I have not met one single fellow traveller who was disappointed. The results to us have been educative, and to our Colonial hosts we hope beneficial and stimulative. We derived great strength from the presence as guests of many foreign professors from Russia, Finland, Sweden, Germany, Austria, France, Japan, and the United States. Canada was also represented. But we owe our great social success to the personality of our genial and learned President, who was all in all throughout the whole trip, who never said a foolish thing, never failed to do the proper one, who displayed infinite tact and judgment, and told tales that will never be forgotten in South Africa.

DISCUSSION.

The Rev. J. O. Bevan thought all the members were much indebted to the able author for the excellent *resumé* he had given of the visit of the British Association to South Africa, but there were one or two slight corrections which he hoped he would be allowed to make. Sir William had said that the East Coast party had returned early in October; as a matter of fact they came back on October 24th. It also might interest Sir William to know that the addresses of the sectional presidents had been published separately, and copies could be obtained at the office of the Association, at the cost of 1s. each. The difficulty of obtaining an efficient supply of teachers in South Africa was a most important question. The South African Colonisation Society, which had an office in London, had a separate Education Department, in connection with which an effort was being made to supply teachers for secondary and elementary schools, and also to provide governesses—in fact teachers of all classes. The author had omitted to mention one interesting fact as the issue of the Association meetings in South Africa, namely, that the members had subscribed a sum of between £700 and £800 in order to found a medal, which would be awarded annually to the most successful student in the South African University. It was also an interesting fact, in connection with the Cullinan Diamond, that it was considered inexpedient to declare its value when it was sent to England, and it was therefore despatched as an ordinary parcel, arriving quite safely in this country. A very great deal of what the author had said upon various burning questions, such as missions and education, might possibly not coincide with the views of those present, but he would not detain the audience by inflicting any further remarks upon them.

Mr. John G. Maydon (British Commissioner of Railways in Natal) said that as a South African he had listened with great pleasure to the impressions which had been created upon a trained mind in a rapid travel throughout South Africa. Sir William Preece had gathered so much of the deepest interest to those engaged in the development of that country, and so much from which he hoped they would be able to shape a policy that would convert a country, only a few years ago, and even now, little more than a desert, full of the wildest barbarities, and still peopled largely by savages, into what it was fast becoming—one of the jewels of the Empire to which they all belonged. South Africans believed on good ground that the visit of the Association, of which the author was so distinguished an ornament, would do much to lead to the proper development of the country. It was very wonderful to him that Sir William should have been able, after so short a visit, to carry away such an accurat impression o what was going on in South Africa. South Africans wanted everybody to be interested in their country, and they believed that England was being more and more interested in it, because England would find in South Africa a field for her sons well worthy of cultivation. All that could happen to familiarise such a field to England was for Africa's good and for England's good; and the deeper the knowledge they had of each other the better it would be for both. He hoped the visit of the Association would be repeated at no very distant date, according to the invitation which was given in Maritzburg by the Governor of Natal; and that when the second visit occurred it would be seen that a good deal of progress had been made, and that South Africa had indeed learned a good deal from the visit of the *savants*, who had just passed through the country. He hoped prosperity awaited both England and South Africa — he was sure it awaited South Africa, and he believed it awaited the Empire. The greater the knowledge children had of the parent, and the greater the knowledge and familiarity of the parent with its latest child, the better it would be for both. On behalf of the small portion of South Africa which he represented—Natal—he thanked Sir William very cordially for the very bright impressions of his visit to that colony that he had laid before the Society.

The Chairman, in proposing a cordial vote of thanks to Sir William for his interesting paper, said he was sure all present would go away the wealthier for what they had heard of the author's impressions

of his visit to South Africa. He sincerely hoped, with Sir William, that Englishmen would not bring any party feeling or party politics to bear upon delicate South African questions, but would approach them with unbiassed minds, because unless that course was adopted the difficulties would be insurmountable. The paper ought to set the people of England thinking upon problems which nearly affected the future of the British Empire: and he trusted they would give their best mind and abilities to solving the very crucial problems with which they were confronted in South Africa. It was exceedingly pleasant to hear a South African speak in the tone adopted by Mr. Maydon, and it was a source of pleasure to think of the worthy sons of the Empire that were being bred in Natal. The impression he had obtained from the paper was that there was undoubtedly a very great future before South Africa — it might not be immediately, but it was certain that in those latitudes at some future time a great drama of human civilization would be played. It was the duty of all Englishmen to bring their quota of thought to the solution of the question, but he again warned them against importing biassed opinions into a discussion of a subject which should be considered with a clear cut mind, free from bias. Everyone should help in endeavouring to solve problems which were undoubtedly difficult, but which he was perfectly certain would, in the end, redound to the efficiency and greatness of the British Empire.

The resolution of thanks was then put, and carried unanimously.

Sir WILLIAM PREECE, after thanking the members for the hearty manner in which his paper had been received, said that the Chairman had expressed almost exactly the feelings with which he went to South Africa, and the feelings with which he had endeavoured to write the paper. The paper consisted of the impressions of an unbiassed mind of what he had learned and seen in South Africa. They were, however, not only his own personal feelings, but they were also shared by the majority of his fellow travellers. He was quite aware, as Mr. Bevan had said, that a good deal of the paper was open to discussion. He was aware that he had trod on some people's corns, and he was not quite sure that he was ready to defend everything he had said. The statements he had made were only impressions of a rather rapid visit, and he placed them at the disposal of the Society for what they were worth. At any rate they were fair, unprejudiced, and non-political. He had never troubled with politics during the whole of his life, and he believed the result was that he had a clearer judgment of what was going on in the world than people who mixed themselves up with different parties, to which, in many cases, they had sold their consciences.

HOME INDUSTRIES.

The Motor Exhibition.—The International Motor Exhibition at Olympia closed on Saturday and may safely be said to have been a great success notwithstanding the fact that the Society of Motor Manufacturers and Traders had already held a very successful show this year. No one could have visited the Exhibition, and given intelligent attention to it, without being impressed by the revolution that the motor has made, and is making, in our daily life. The motor spreads more and more and always at the expense of the horse. An immense number of orders are said to have been booked at the show, and one is tempted to ask where all the money comes from. Here reference is not made to the satisfaction of business requirements but to the purchases of persons who buy motor-cars for travelling purposes. These machines remain extremely costly and even now-a-days the number of millionaires, or very rich persons, is not large. Land owners who are not in the happy position of having town property, or mines, or the like, have not as a rule large surpluses for luxuries, and to the man with an income of £4,000 or £5,000 a year the purchase of a first rate, up-to-date motor-car must be a transaction of considerable importance. Not only is no credit given by manufacturers but most of them want a deposit of a third of the purchase money with the order. And yet the leading stands at the late Exhibition seemed to be always alive with visitors who looked purchasers. Probably a good deal of the money that goes to the motor-car manufacturer finds its way to him at the expense of other trades interested in luxury, more especially the jewellery trade which is generally the first to suffer. Be that as it may, the Exhibition at Olympia affords striking evidence of the vastness of this new trade, and of the revolution it is making in the national life.

The Hosiery Industry.—Reference has recently been made on this page to the recovery in two great industries, the tin-plate and corrugated iron, and there has been an equally remarkable revival, in its way, in the hosiery trade. The scarcity of raw wool, and the consequent high prices, led to stocks being kept unusually low, and the cold weather caused a clearance more complete than has been seen for many years. Concurrently with this home revival there has been a great expansion in the orders from the Colonies, and there has been a considerable increase in the demand from India and other Eastern markets. "The fabrics," says the Leicester correspondent of *The Times*, "are sent out as fast as the machines can produce them, but many manufacturers are about two-thirds behind in their deliveries, notwithstanding the fact that overtime is being worked ar far as possible to cope with the demands. A further expansion is confidently expected." Having regard to the late war, and the internal condition of the country, it is surprising how wool imports from Russia have been maintained and increased. In 1904 the imports for the nine months ended September 30th

were 2,767,302 lbs.; in 1905, 3,575,688 lbs. Taking the same period, there were considerable decreases in the imports from Uruguay and British South Africa. The imports from Australia increased from 166,331,106 lbs. to 183,700,288 lbs., and from the Argentine they jumped from 10,951,485 lbs. to 22,761,677 lbs., the increase for the month of September being as from 218,010 lbs. to 985,105 lbs.

Rubber.—The rubber market is evidently of the opinion that the demand will soon leave supply far behind. There is plenty of rubber in the world but the trouble is to get it, and, it must be added, the unscientific and imperfectly controlled collection leads to great waste of the sources of supply. For example, in his report just issued, on the trade of Northern Nigeria, Mr. F. Lugard says "there are very valuable areas containing rubber which are either untapped or are being destroyed by injudicious methods," and elsewhere he says, referring to the visit of inspection of Mr. Elliott, the forestry officer, to Illorin, and along the southern frontier, "He (Mr. Elliott) visited and explored the Gurara river and the rich Koton-Karifi district, proceeding to Kaffi through a rubber-producing country, and returning to the Benue at Loko. He also made a tour through Bassa, where he reported the wholesale destruction of rubber vines by the digging up of their roots for the so-called 'root-rubber.' Acting on this expert testimony, I at once prepared a Forestry Proclamation with the principal object of arresting this destruction, and of preserving the valuable timber trees of the country." As in Northern Nigeria, so elsewhere, the sources of supply are being seriously interfered with by reckless treatment of the trees. There does not seem to be any complete remedy for it so far as what may be called wild rubber is concerned. Adequate supervision over the immense areas from which the rubber is collected would seem to be impossible, and as the supply near the waterways decreases the cost of collection must increase, however plentiful the supply in virgin forests. Having regard to the great and increasing demand for rubber, a demand that must increase rapidly with the development of the motor industry, it may be expected that rubber plantations will grow in at least proportionate degree.

British Trade with Canada.—Attention has recently been directed in the *Journal* to the comparatively small advantage accruing to British trade from the Canadian preferential tariff in favour of the United Kingdom. In its issue of November 11, Bradstreets direct attention to the subject and arrive at similar conclusions. The increase in Canadian imports from the United States to Canada is, says the American authority, striking, "in fact, when one considers the legislative barriers placed in the way of trade between the two countries, and the remarkable expansion that has taken place in the import trade from the United States in spite of the efforts to divert the business into other channels, the conclusion must be that the geographical position is, after all, in that connection, the most important influence." There can be no doubt as to the comparative increase of American imports, as the following figures show:—

	1897.		1905.
Great Britain..	77,227,000 dols.	..	101,958,000 dols.
United States .	41,933,000 dols.	..	77,404,000 dols.

But whether this entirely sustains the view as to the decisive effect of geographical position is open to question. Between 1873 and 1904 the imports from France to Canada increased nearly four-fold, from Germany nearly nine-fold, the same from Holland, but from the United States considerably less than three-fold, although, of course, in the case of the United States the aggregate is enormously larger.

The Character of the British Exports.—Distance does not prevent Great Britain commanding very distant markets as against countries that are contiguous to them, and we do so because we can supply a better or cheaper article, or both. For example, last year we exported goods to the value of £4,335,957 to Hong Kong, and our goods were used, and distributed from there, notwithstanding the contiguity of China. The day may come when China and Japan will supply the cottons, valued at over a million and a-half, we sent to Hong Kong from the United Kingdom last year, but these countries cannot supply them now because the British product is preferred by Eastern markets. And so with the United States and Canada. Proximity is of course an enormous advantage, but proximity does not prevent Great Britain sending to Canada painted, dyed, or coloured fabrics of seven times the value of those imported from the United States. So with earthenware and china ware, fancy goods, clothing, Canada plates, mats, and rugs, oilcloth, silk fabrics, whiskey, tobacco pipes, cassimeres, cloths, and doeskins, tweeds, woven or partly woven fabrics, carpets, tins in plates and sheets, and much else. Canadian imports from the United States consist largely of fruit, oils, and skins, provisions, tobacco, wood, cotton, breadstuffs, which Great Britain could not supply if she were as near Canada as the United States, and no preferential tariff would enable her to supply them, for the sufficient reason that she does not produce them, or produces insufficiently for her own requirements.

Machinery for the Transvaal.—It is to be feared that the United States and Germany are getting a large proportion of the orders for machinery, &c., given out at Johannesberg, and that in some degree, to say the least, these orders might have come to the United Kingdom if our manufacturers had shown greater resource and assiduity in looking for them. It was quite obvious that after the war there would be a great demand for mining and other machinery. The mines, some of them, had been

wrecked, all of them had suffered from enforced idleness, and the rapid expansion of the mining industry when the war ended was confidently predicted. The revival of this industry and consequent demand for machinery, did not come as quickly as was expected, but it was certain to come, and now the gold output exceeds that of 1899, and the growth of the industry in the immediate future is expected to be rapid. The Americans and the Germans worked the ground very diligently, and now they are reaping the reward. British manufacturers ought to have had a great initial advantage, but as was demonstrated in the exhaustive official report to the Board of Trade issued some time ago, they have allowed their foreign competitors to book the orders, or, at any rate, a large number of them. The representatives of the British firms are said to be less up to their work, less assiduous and ingenious in canvassing, and less free than their competitors to offer advantageous terms. In a word, British business in this direction is cramped by antiquated procedure, and the foreigner and the American are the gainers.

The Import of Doors, Frameworks, &c.—In his speech at Bristol Mr. Chamberlain directed attention to "the cargoes of ready made doors" delivered in England, whereby British carpenters are deprived of lawful work. Whatever may be said for or against this unchecked importation it is a fact, but the imports are not on the increase. Indeed they show substantial diminution. In 1900, the imports of manufactures of furniture, house frames, &c.—the returns do not differentiate "doors," but they include them—were valued at £973,158; in 1904 at only £686,221. More than half the total shipments—excluding the Colonies—came from the United States, Sweden coming next with a value of £130,120 in 1900, and £113,930 in 1904; Germany comes third, with £101,959 and £76,154 respectively. Canada supplies a little, but even her exports under this head were smaller in 1904 than 1903, being of the value of £51,186 as against £61,092 1903.

RUBBER.

The rubber industry is of comparatively recent growth. As far back as 1770 Priestley recommended rubber for erasing lead pencil marks, but it was not until more than half a century later that it began to be used for waterproof garments, some of them still known by the name of their inventor, Macintosh. In 1836 Thomas Hancock discovered that crude rubber could be worked up and converted into practically any shape or form, but it was not until 1874, when the method of vulcanising rubber by heating and treating it with sulphur was discovered, that rubber became an important article of commerce. At the time of this discovery the imports of rubber into England amounted to about 7,500 tons, five years later they reached 20,000 tons, in 1900 they rose to 25,664 tons, the highest on record. The present total production of rubber is about 70,000 tons, of which nearly 30,000 comes from Para. The increase in the demand for rubber has been stimulated by the requirements of cycle, carriage, and motor tyre manufacturers, and of the makers of electrical appliances. In the United States the demand for it is also very great for the purposes of footwear. In 1902-3 the value of unmanufactured India rubber and gutta percha imported into the United States was 26,092,000 dols., in 1904-5 it had risen to 46,266,000 dols. It is estimated that the world's annual consumption of rubber at the present time exceeds £16,000,000 in value.

In one respect the rubber industry is a singular one. The larger portion of the rubber that comes into the markets of the world comes from the virgin forest where the tree that produces it owes nothing to artificial cultivation. In one way the collector of rubber resembles the collector of ivory. Both find what they seek in the primæval forest, but the ivory hunter must kill the elephant from which he gets his tusks, the rubber collector extracts what quickly becomes rubber from the tree without necessarily injuring it. Although in some places from which rubber is obtained, more especially Africa, the reckless way in which the rubber has been collected has seriously affected the output, the possible supplies would seem to be ample. Rubber is to be found in immense tracts of country, from Mexico to Paraguay, in America; from Cape Blanco across Africa and down to the latitude of Madagascar, and on that great island; from Assam southward in Asia to Malacca, Borneo, New Guinea, and a northern patch of Australia. Until recently rubber was obtained solely from plants growing wild, but the cultivation of rubber-producing plants has now been undertaken on a somewhat extensive scale. The cost of opening and maintaining a plantation until productive is considerable. It varies, of course, with the nature of the jungle to be cleared and the land to be worked; but taking Ceylon, Mr. Ardan, in his report on *Hevea brasiliensis* in the Malay Peninsula gives the following items as representing the cost of opening 500 acres of land, and planting with rubber 20 feet by 20 feet apart, being 108 trees per acre. The total expenditure he puts at $64,875, being an average of $50·55 per acre for clearing and planting, and $19·80 per acre for upkeep, including the manager's salary. Taking the rate of exchange at 1s. 10d., this is equivalent to £5,946 17s. 6d. sterling, or an average of £11 7s. 10½d. per acre, to which must be added the interest on all money expended. It might be thought that this considerable outlay would prevent the rubber produced on these plantations from competing with that collected by natives from wild trees. But it has to be remembered that the collection of what may be called wild rubber is expensive, and necessarily tends to become more so as the trees

nearest the coast are exhausted. The collector of rubber from wild trees has to take long and arduous journeys, of several weeks duration, in order to reach a rubber-producing district, and the collection of rubber in a mixed forest, where rubber trees are comparatively scarce, is much more expensive than in a plantation. It is not always easy to get men to do the work, and the difficulties of transport are often great. Then again, there is no comparison between the facilities provided on a plantation for curing rubber and those obtainable in a forest. It must be remembered too, that the rubber prepared from cultivated trees fetches a better price—sometimes from 1s. to 1s. 6d. per lb. higher—than that collected from wild trees, because it is purer. The loss from "fine Para" is from 10 to 15 per cent. in manufacture, whereas that from the "biscuit" rubber prepared from cultivated Para rubber trees is generally less than 1 per cent. Whilst it must be a long time before the wild rubber trees cease to be relied upon for rubber, the advantage of this method of collection as compared with plantation growth is much less than may be supposed by those who have not gone into the matter carefully. The cultivation of rubber trees is already a considerable industry in India, Ceylon, and more particularly, the Malay Peninsula. A few Para rubber estates, says the Governor; Deputy in the Straits Settlement, in his last report, were started recently in the island (Singapore), "but it is hardly likely that these will increase to any great extent, as there is not much land suited for this cultivation. In Province Wellesley, and Malacca, however, there is a marked increase in rubber cultivation, and still more so in the Federated Malay States. The area under cultivation now in the Peninsula is very large, and the prepared rubber is in great demand by the home manufacturers, the best samples having taken the highest price ever paid, in 1904, viz., 6s. 1½d. per lb."

Para rubber has practically ruled the market price of rubber since its first introduction to commerce, and Para still exports a much larger quantity of rubber than any other country. In 1902 the exports of rubber from Para and Amazonas to the United Kingdom were 11,794 tons, valued at £3,200,000, and in 1903 12,228 tons, valued at £4,000,000; the total exports of rubber from Para amounting in the one year to 27,112 tons, and in the other to 29,008 tons. The director of the local botanic gardens reports in the bulletin of the Para Museum that it has been recently discovered, by a person unconnected with the production of rubber, that a latex obtained from a tree entirely different from the "Heveas," has been employed not only to adulterate rubber, but even in some cases to replace it altogether. Experienced estate owners believe the substitute to be slightly less elastic than the genuine article. It seems that the great demand has led to the practice for some years past. The trees in question are plentiful, and exist over a very wide area, and are known in the State of Amazonas by the name of "Tapurú," and in the neighbourhood of Para as "Marupita," "Seringa Rana," &c. Botanists are of opinion that these trees belong to a species of "Sapium." The word "Tapurú" is the Indian name for an insect, and is given to the trees because they are frequently destroyed by termites, particularly when tapping has been performed by unskilful hands. The advantages of the "Tapurú" and its congeners consist in their being more plentiful than the "Heveas," and in their more rapid reproduction. Speaking of adulteration, there is reason to believe that the quality of the products of the rubber industry has deteriorated from year to year, and this is attributed in some degree to the ignorance of the consuming public regarding the origin and the nature of the raw materials used for rubber goods production. "Whereas," says Mr. Clouette, in his well-known and standard work on rubber, "every educated layman has a proper knowledge of most industrial products, and also of the nature of the methods and the use of the employed raw materials, even engineers, technical men, and chemists, in whose work and undertakings the products of the caoutchouc industry play an important part, know very little about the subject. Often they cannot distinguish gutta-percha and caoutchouc, soft and hard rubber, and it has happened that they have mistaken heterogeneous materials, such as animal glue, for caoutchouc. About the raw material and its origin the knowledge seldom extends further than that Brazil supplies the best rubber through the shipping port of Para, and the best quality is therefore called Para. Of the large number of Para sorts and their distinction nothing is known. A similar ignorance exists with regard to the methods of production of goods; some have an idea that rubber goods are moulded or cast in the same way as metal or plaster. It is therefore no matter of surprise that quality cannot be judged accurately. It is difficult to judge the quality, as colour, smell, and specific weight are not reliable points for fixing it; the quality depends in the first place on the kind and the origin of the raw caoutchouc. The kind and origin cannot be fixed in vulcanised rubber, not even by chemical analysis, as this can only give the proximate percentage of the materials in the mixing, but cannot fix the quality."

The European central market for raw caoutchouc is Liverpool, London importing less than a seventeenth of the quantity of caoutchouc that goes to Liverpool. Hamburg has grown immensely in importance as a raw caoutchouc market, and has more than doubled its direct import in the last ten years. The opening of the Central Congo districts has given a great impetus to the rubber imports of Antwerp. The trade to that port has enormously increased in recent years. In 1889, the import was only 5 tons; in 1904, the Congo alone exported to Belgium 5,662 tons, valued at £1,821,480. The Para qualities (fine Para and negroheads) give the standard for the prices of the other kinds, which always range in proportion to the quotation for these best two products. The lowest

price for fine Para was in September and October, 1861, when it fell to 1s. 6d. In 1882 it touched 4s. 11d. In 1902 it was as low as 3s., but since then it has reached a higher figure than ever, and Para is now quoted at 5s. 2d., thanks to American manipulators, other descriptions being quoted down to 3s., but cultivated rubber fetching 6s.

In addition to supplying the market with the best rubber, cultivators of *Hevea brasiliensis* may be able to claim a share in the immense market which provides the world with vegetable oils. It might not pay to collect the seeds in the Amazonas forest, but the excessive cost of collection and transport does not apply to the plantations. About 150 decorticated fresh seeds weigh a pound, which is about 340,000 to the ton. It is estimated that a Para tree produces on an average 400 seeds per year, so that about a quarter of a ton would be produced per acre. The seed kernels contain 50 per cent. of oil of a light yellow colour somewhat resembling linseed oil. Analysis shows that a cake prepared from Para rubber seed meal would compare favourably with other cakes as a cattle food, and that it contains a particularly low proportion of indigestible matter, that is to say, fibre. Specimens of both the seeds and oil have been submitted to leading brokers. They report that the oil could probably be used as a substitute for linseed oil, and would be worth at present about £20 per ton, but that oil merchants would not take it up unless they first had an opportunity of testing it in bulk. The brokers consider that it would be more profitable to ship the seeds themselves to this country as is done in the case of most other oil seeds. They value the decorticated seeds at £10 to £12 per ton. Much interesting information on this point, and other matters connected with rubber, will be found in Mr. W. H. Johnston's "The Cultivation and Preparation of Para Rubber."

THE JAPANESE SILK TRADE.

The rearing of silkworms in Japan is usually engaged in as an auxiliary industry by farmers, whose wives and children assist in attending to the worms, but reports on the subject do not state the number of persons so employed, instead, they give the number of families, which, in 1901, was 475,819. The average production per family was five bushels of cocoons. As a result of the industry being carried on in the homes, there is no fixed division of labour, and it is not possible to give the number engaged in the silk industry, but 18,138 families are stated to be employed in manufacturing egg cards. Women employed to look after the silkworms receive about 5d. a day and board, and men engaged in the same work receive about 7½d. a day and board. The employment of children for wages is not referred to in the official Japanese reports. There are three cocoon crops a year, and each require from thirty to forty days' work. The conditions of this work are too variable to permit of any statement regarding the average number of hours of labour per day. The mulberry trees receive special attention, their treatment varying according to the climatic conditions of the various localities. In 1901 the number of acres planted with mulberry trees was 559,095. Besides this, the tree is often planted to form fences, the borders of farms, or hedges about houses, and it is estimated that more than one-fourth of the supply of leaves used for feeding silkworms is furnished by these hedges. According to the American Consul-General at Yokohama, two methods of reeling are in use, machine-reeling and frame-reeling; the former being employed only in factories, while the latter is used both in factories and the homes of farmers, where the reeling of silk often constitutes a by-industry. Counting as factories all establishments that employ ten or more operatives, there were, in 1900, 2,072 machine-reeling factories, employing 122,116 pans, and 597 frame-reeling factories, employing 55,022 pans. In that year 8,258,492 lbs. of silk were turned out by machine-reeling, and 6,372,766 lbs. by frame-reeling. As the average produce per pan was 64 lbs. by machine, and 36 lbs. by frame, it is evident that about 122,000 pans were used in establishments employing frame-reeling, but having less than ten operatives each—that is to say, in the homes of farmers. The cost of producing 100 lbs. of raw silk by machine-reeling was at that time £12 3s., and by frame-reeling £10 1s. Owing to a great rise in prices it is probably somewhat greater now. At the end of 1900 there were 2,129 silk-reeling factories run by motors, in which were employed 6,252 male operatives and 103,084 female operatives; 429 factories not run by motors employed 774 male and 8,694 female operatives. The Tomioka filature established by the Government led the way in introducing the factory system in silk reeling, and has been utilised as a kind of experimental establishment to determine the best method of preserving cocoons and the systems of reeling best adapted to the condition of the country. In 1903 a course of study was added in one of the Government Sericultural Schools to provide training in the manufacture of silk. In 1894 the Government established two silk conditioning houses, of which the one at Yokohama is still in operation. It undertakes to determine the gross weight of silk by examining it when packed; the net weight of silk by taking into account the quantity of moisture contained in it; the number of breakages by re-reeling the silk, and the rate of such breakages per reel; the size of filaments and their relative uniformity; the relative number of knots in the filaments; the strength and tenacity of the filaments; the relative quantities of gummy substances present in the filaments, and the relative decrease in the quantity by softening. The Japanese Government does not aid in establishing markets for the purchase and sale of cocoons, but in 1884 it opened a sericultural laboratory, in which all sorts of investigations con-

nected with sericulture were made, and where young men sent by sericulturists from all parts of the country received instruction. In 1896, this institution was changed into a sericultural school, and in 1899 another similar school was established in another part of the country. These schools have charge of the following matters:— Instruction in sericulture, experiments and investigations in sericulture, lectures on sericulture, distribution of silkworms' eggs, and attending to enquiries. Two courses of study are provided; one extending over two years, gives instruction in the scientific principles and practices of sericulture, and the other, of only five months, teaches the elementary principles of the industry and devotes attention to the practical side of the work. In 1901, a special course was added for the benefit of experienced sericulturists who wish to study the diseases of silkworms. There are also scattered throughout the provinces, 39 public and 86 private schools which give instruction in practical sericulture. As a result of work done in the sericultural laboratory, Pasteur's cellular method for fighting the silkworm epidemic was remodelled and improved, so as to prove an effective means of abating this evil. Regulations enforced by the Government for the examination of silkworm eggs have resulted in raising the standard of quality of eggs and hindering the spread of epidemics. A law passed in March, 1900, provided for the organisation of credit guilds for the protection of farmers and small manufacturers. These guilds receive assistance from the Government, besides being exempt from the payment of income and business taxes. There are 77 raw silk guilds, and the sericultural guilds. Their object is to advance the industry they represent, and to maintain a high standard of excellence in the exports of the commodities with which they are concerned.

LORD CURZON AND THE ECONOMIC PROSPECTS OF INDIA.

Lord Curzon, in replying to an address presented to him by the Bombay Chamber of Commerce on the 8th of November, said that the sum total of his own experience in the last seven years was to send him away a convinced optimist as to the economic and industrial prospects of India. He argued that the improvement dates from the closing of the mints by Lord Lansdowne and Sir David Barbour, and he contrasted the figures from 1893-4 with those of 1904-5. He proceeded:—

"The capital sunk by Government in railways and irrigation works has increased by 56 per cent. in that interval; that invested by joint-stock companies in industrial undertakings by 23 per cent. The Savings Banks deposits have gone up by 43 per cent., the private deposits in Presidency Banks by 71 per cent., the deposits in other joint-stock banks by 130 per cent., the deposits in Exchange Banks by 95 per cent., Government paper held in India by 29 per cent., the amount invested in Local Authorities debentures by 90 per cent. The amount of income on which Income-tax is assessed — excluding at both periods the incomes now exempted—has increased by 29 per cent., the rupee circulation by 27 per cent., the note circulation in active use by 68 per cent. The net absorption of gold in the ten years preceding the two dates of enquiry, namely 1893-4 and 1904-5, shows an increase of 120 per cent. in the latter, of silver 136 per cent. The total value of Indian imports has gone up 35 per cent., of exports 48 per cent. The productive debt has increased in the same period by 69 crores, but the non-productive debt has decreased by 16 crores. Now these figures, which I have had specially prepared for you, are worth thinking over. From whatever point of view you regard them, bearing in mind that these considerable, and in some case amazing, increases have occurred in a period in which the increase in the population has only been 4 per cent., it is impossible to deny their collective testimony to an advance in every test that can be applied to the progress of a nation, which is without example in the previous history of India, and rare in the history of any people."

In the same speech he referred to railway extension during his Viceroyalty. The highest total mileage hitherto recorded in any Viceroyalty, he observed, has been 3,928; in mine we have laid 6,110 miles, bringing up the total mileage in India to 28,150, and I believe and hope that these figures will be exceded by my successors. The highest capital outlay in any previous Viceroyalty has been $47\frac{1}{4}$ crores, we have expended nearly 60 crores, bringing up the total capital sunk in Indian railways to 240 millions sterling. There has never before been a railway surplus; the aggregate railway surpluses of the past six years have amounted to $4\frac{1}{2}$ millions sterling.

THE SOCIETY OF ARTS IN 1805.

The *Observer* has recently been publishing as supplements reproductions of its issues of a hundred years ago. In one of these, the number for Sunday, Nov. 17, 1805 (reprinted as the supplement to the paper for Sunday, Nov. 16, 1905), occurs the following advertisement, which is interesting in connection with the history of this Society:—

SOCIETY FOR THE ENCOURAGMENT OF ARTS, MANUFACTURES, AND COMMERCE.——*Adelphi, Nov.* 13, 1805.

ALL Persons who propose to become Candidates for the Office of ASSISTANT SECRETARY to this Society, in the room of Mr. THOMAS TAYLOR, resigned, are hereby desired to take Notice that they are to attend at the Society on or before Wednesday, the 22d of January next, and personally present their Memorials in their own Hand-writing.

A New Edition of the First Volume of the SOCIETY'S TRANSACTIONS is now in the Press, and will speedily be published. Complete sets may then be had from the Housekeeper.

By Order, CHARLES TAYLOR, Secretary.

The Election will take place on Wednesday, the 5th day of February next.

The Thomas Taylor here referred to was the famous Taylor, the Platonist (born 1758, died 1835), who in 1798 resigned a clerkship in Lubbock's bank to become Assistant Secretary of the Society of Arts. In October, 1804, he obtained leave of absence in consequence of illness, and his son acted as his deputy until his resignation. A new Assistant Secretary was elected at an Extraordinary General Meeting held on February 5, 1806. There were three candidates, and Charles Combe was elected by a large majority. In the life of Thomas Taylor, in the "Dictionary of National Biography," it is stated that he resigned his office "in order to devote himself more assiduously to the work of translating and expounding the ancient thinkers."

NOTES ON BOOKS.

THE CRYSTALLISATION OF IRON AND STEEL. By J. W. Mellor, D.Sc. London: Longmans, Green and Co.

In 1857, Dr. H. C. Sorby made the first application of microscopy to the investigation of the structure of iron and steel, and during the last fifteen years this branch of science has made astonishing progress, and the far-reaching importance of knowledge derived from the researches of Osmond, Roberts-Austen, Stead, Arnold, Martens and others is now universally recognised. Much light is being thrown upon the internal structure of metals and alloys, and explanations are being afforded of many phenomena connected with the industrial treatment of metals. Unfortunately, the facts arrived at have been to a certain extent obscured by controversy regarding details in discussions at meetings of the Iron and Steel Institute, and it has been difficult in consequence for the uninitiated to get into touch with the work. Dr. Mellor's book is therefore a welcome addition to technical literature. Comprising a course of six lectures, it gives a summary of the results of the more important researches which have been mude during the last ten years upon the constitution of iron and steel alloys. Written from an impartial standpoint by one who has taken no part in the debates, it illustrates the truth of the maxim that observers see most of the game; and its 144 pages contain in clear and concise form all the salient facts and theories regarding the solidification and cooling of alloys, the constituents of iron and steel, the hardening, annealing and tempering of steel, the crystallisation of iron and steel, the influence of stress and strain, and instruction for the preparation of specimens for the microscope. The book as a whole cannot fail to impress those who have not specially studied the subject with the remarkable character of the work that is being carried on by practical metallurgists in the domain of physical chemistry.

A GEOMETRICAL POLITICAL ECONOMY: Being an Elementary Treatise on the Method of Explaining Some of the Theories of Pure Economic Science by Means of Diagrams. By H. Cunynghame, C.B., M.A. Oxford (Clarendon Press).

The title of this practical little book to a large extent explains the object which the author has in view. In his preface he excuses his use of the word "geometrical." The curves employed are rather graphic than truly geometrical, but Mr. Cunynghame foresaw that although "diagrammatic" might have better expressed the nature of the work, it would be open to misconstruction. He refers to the obligations which Englissh students are under to Professor Marshall and to the late Fleeming Jenkin and Stanley Jevons for introducing this method into England. In the earlier chapters he discusses the different kinds of diagrams used in dealing with concrete facts, such as those showing the relation between the output of coal over a series of years, and accidents in mines during the same period. In the later chapters he deals with abstract theories and their exposition in diagrammatic form, as in the case of the equilibrium between demand and supply. The author sees clearly the difficulties that beset his method, and, in fact, points out some of them in his preface, when he says:—"A writer who attempts to use curves to explain political economy is open always to two dangers. If he makes his curves very simple he is liable to be accused of not having seen the necessary qualifications to which economic laws are subject, and to be considered crude and wanting in subtlety. If, on the other hand, he attempts to enunciate every proposition with all the necessary safeguards, qualifications, exceptions, and explanations, his system becomes overloaded, like the epicycles in the closing period of the Ptolemaic Astronomy. I have, however, preferred simplicity, even at the risk of being considered inadequate."

ELEMENTARY PRACTICAL METALLURGY: IRON AND STEEL. By Percy Longmuir. London: Longmans, Green and Co.

Ever since Professor H. Bauerman published, in 1868, in Weale's series, his invaluable small treatise on the metallurgy of iron, there has been a constant succession of metallurgical text-books issued, and it would almost appear that an addition to their number was uncalled for. Metallurgy, however, is an art in which rapid strides are being made, and text-books soon become antiquated. Moreover, by a careful

combination of practical and theoretical information, Mr. Longmuir has presented his little book in a form that should certainly prove acceptable to the student. He has refrained from overloading it with detail, and, while taking full advantage of his experience as a practical man, has subordinated the theoretical considerations which his training as a Carnegie Scholar and Medallist of the Iron and Steel Institute might have tempted him to bring into prominence. His arrangement of his subject-matter presents little novelty. He deals successively with refractory materials, metallurgical fuels, iron ores, the blast furnace, the properties of cast iron, malleable cast iron, wrought iron, the cementative process, steel, the crucible process, the Bessemer process, the open-hearth process, the production of sound steel, metallography and special steels. The chapters on cast iron and on crucible steel-making, contain many valuable practical hints, and are deserving of special commendation. The section on metallography is illustrated by some remarkably good reproductions of photomicrographs. In this section, the author's views are in accord with those of his teachers, Professor Arnold and Mr. McWilliam, to whom he dedicated the volume; but the names of others holding other opinions are not mentioned. The least satisfactory section is that dealing with coke. It might have been better to have utilised the space devoted to the obsolete Appolt oven, for mentioning the latest type of coke ovens with which, at Middlesbrough and elsewhere, such remarkable results are being obtained in the recovery of by-products. These, however, are matters of slight importance. The book is an excellent introduction to the metallurgy of iron that should appeal alike to the student and to the general reader.

"Punch" Almanack for 1906 contains a double-page illustration colour plate, by Mr. Bernard Partridge, entitled "A Medley of Modes," which is of interest as it is the first occasion on which a picture painted in colours has been used in the pages of *Punch*. The cover, by Mr. Hassall, is also in colours.

OBITUARY.

Dr. Diego Cardoz.—Dr. Cardoz, Senior Assistant Surgeon of Hubli (Bombay), a Member of the Society of Arts since 1900, died in that town on the 13th of May last, at the age of 54. He joined the Medical Department in 1872, and in 1878 he was sent to Malta with the troops despatched to that island from India while the treaty of peace between Russia and Turkey was being discussed at Berlin. From 1880 to 1886 he was in charge of the medical dispensary at Gadag, and for three years he held the post of vice-president of the municipality, during which period he is said to have greatly improved the sanitation of the town. He was highly esteemed, both for his professional attainments and for his interest in the improvement of Hubli. Is is stated in a local paper that the Hubli Waterworks, the Municipal Hall, the Civil Hospital, and the Lamington High School owed much to his initiative. He is said to have been an advocate of plague inoculation and to have been very active during the epidemic of 1897-98; for these and other services the Viceroy decorated him with the Kaisar-i-Hind medal of the second class.

Henry Barcroft.—Mr. Barcroft, late High Sheriff and Deputy-Lieutenant of County Armagh, died on the 18th November, aged 66 years. He took an active part in all movements for the improvement of Newry and its neighbourhood. He was chairman of the Newry Free Library Committee, a director of the Dundalk and Newry Steamship Company, and for some years president of the local Chamber of Commerce. He was active in the management of the Bessbrook Spinning Company, and in the formation of the Newry and Bessbrook Tramway. He was a director of the Pleasure Steamers of Ireland, Limited, and invented a new propeller for steamers. Mr. Barcroft was elected a member of the Society of Arts in 1880.

GENERAL NOTES.

Meat from Uraguay.—It looks as if a good deal of frozen meat may be exported from Uraguay before long. In his report on the trade of the Republic for 1904 Mr. Consul Kestall-Cornish says that early in the present year the first consignment of frozen meat ever exported from Uraguay, and which was prepared by the recently established factory known as the "Frigorifico Uruguaya," was shipped to the United Kingdom, and this consignment was followed in March by another consignment, and the export has been maintained in like manner up to the present time. The active working of this establishment, which was built and ready for use in 1903, although the Revolution interfered with its being worked, signifies a new and very important departure in the preparation of Uragayan meat for export. The frozen meat will no doubt take the place, to a large extent, of the more primitive jerked beef in the export trade of the county.

St. Vincent.—The Administrator's report on the Blue-book of St. Vincent for the year ending 1904-5 (Cd. 2684) shows that the colony is slowly recovering from the terrible devastation caused by the eruption some years ago. Mr. Cameron says that large areas of land on the windward side are still untouched save for the reaping of a considerable quantity of native cane, which, having had vitality enough to survive the effects of the volcanic blast, has now sprouted and thrown up luxuriant

stocks. Large areas of land are still, however, no more than a cindery waste, and in an ascent which Mr. Cameron made to the summit of the Soufrière crater in April last for the purpose of observing conditions, he was much struck by the havoc wrought by water, as well as the depth and uncompromising consistency of the scoriæ, and the consequent difficulty and expense that must be attendant on any attempt at systematised cultivation. It is satisfactory to learn from Mr. Cameron that the cotton prospects are encouraging, though disease occasioned loss in some localities, and the total yield in comparison with acreage in cultivation is disappointing. In quality the cotton left little to be desired and an all round price of 1s. 5d. per lb. was reached. St. Vincent indeed is, says Mr. Cameron, in the position of having produced "the highest priced cotton in the Empire, and as a result there has been a great demand for the St. Vincent seed, large quantities of which have been disposed of at a satisfactory price, after undergoing careful selection and disinfection at the hands of the agricultural officers."

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

December 6.—"The Manufacture of Sugar from British-grown Beet." By Sigmund Stein. The Right Hon. the Earl of Denbigh, C.V.O., will preside.

December 13.—"The Commerce and Industry of Japan." By W. F. Mitchell. His Excellency the Japanese Minister, will preside.

December 20.—"The Aerograph Method of Distributing Colour." By Charles L. Burdick.

Indian Section.

Thursday afternoon, at 4.30 o'clock:—

December 7.—"The Partition of Bengal." By Sir James Bourdillon, K.C.S.I. The Right Hon. Lord George Hamilton, G.C.S.I., M.P., will preside.

Colonial Section.

Thursday afternoon, at 4.30 o'clock:—

December 14.—"Glimpses of French Canada." By the Hon. Rodolphe Lemieux, K.C., M.P., Solicitor-General of Canada. The Right Hon. Lord Strathcona, G.C.M.G., will preside.

Applied Art Section.

Tuesday Evening, at 8 o'clock:—

December 12.—"Historical Pageants." By Louis N. Parker. Sir Marcus Samuel, Bart., Vice-President of the Society, will preside.

Papers for meetings after Christmas:—

"London Traffic." By Captain G. S. C. Swinton (L.C.C.).

"The Preparation of Oxygen from Liquid Air." By Monsieur Raoul Pictet.

"Submarine Signalling." By J. B. Millet.

"The Supply of Electricity." By James N. Shoolbred, B.A., M.Inst.C.E.

"The Planting of Waste Lands for Profit." By Dr. J. Nisbet.

"Industrial Russia." By Lucien Wolf.

"The Horseless Carriage, 1885-1905." By Claude Johnson.

"The Artistic in Painting and Photography." By J. C. Dollman, R.I.

"Illuminated MSS." By H. Yates Thompson.

"The City of Calcutta." By Charles Edward Buckland, C.I.E.

"The Languages of India and the Linguistic Survey." By Dr. George A. Grierson, C.I.E., Ph.D., D.Lit.

"Seistan: Past and Present." By Colonel Arthur Henry McMahon, C.S.I.

"The Navigable Waterways of India." By Robert Burton Buckley, C.S.I.

"The Parsis of Persia." By Major Percy Molesworth Sykes, C.M.G.

"Progress in Electric Lighting." By Leon Gaster, A.M.I.E.E.

"Imperial Questions in the West Indies." By Sir Nevile Lubbock, K.C.M.G.

"Motor Boats." By Bernard B. Redwood, B.A.

"The Scientific Aspects of Voice Development." By William A. Aikin, M.D.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

J. A. Fleming, D.Sc., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (In continuation of previous courses on "Electric Oscillations and Electric Waves," and on "Hertzian Wave Telegraphy.") Four Lectures.

Lecture II.—December 4.—*Measurement of High Frequent Voltage and Current.*—Damping of electrical oscillations—Maximum and mean-square values—The damping factor and logarithmic decrement—The resistance decrement and radiation decrement—Damping due to dielectric hysteresis and magnetisation—Methods of determining maximum and mean-square voltage—Spark voltage in air at various pressures—Electrometer measurements—Calculation of maximum currents during discharge—Methods of determining logarithmic decrements employed by Rutherford, Bjerknes, Drude and others—Analysis of the discharge of a Leyden jar, or condenser.

LECTURE III.—DECEMBER 11.—*Measurement of Frequency and Resonance.*—Time period and oscillation constant of a condenser circuit—Closed and open circuit syntonic circuits—Theory of resonance—Experiments illustrating resonance—Resonance curves—Determination of the total decrement from resonance curves—The Cymometer—Its use for determining small capacities and inductances—Theory of the oscillation transformer—Analysis of the phenomena of the oscillation transformer by the aid of the Cymometer.

LECTURE IV.—DECEMBER 18.—*Measurement of Free and Stationary Wave-Length.*—Stationary waves on wires—Velocity of propagation—Mechanical model—Loops and nodes of potential and current—Special qualities of spirals—Methods of detecting loops and nodes—Radiation from aërial wires—Velocity of free waves—Relations of free-wave lengths to antenna length—Direct and inductively coupled aërials—Determination of the wave-length and damping of the waves radiated from antennæ—Methods of syntonising coupled circuits with the Cymometer.

HOWARD LECTURES.

A Course of Three Lectures will be given under the Howard Trust, by PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., on "High Speed Electric Generators, with special reference to driving by Steam-turbines," on the followng Thursday Evenings, at 8 o'clock:—January 18th and 25th, and February 1st.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. J. A. Fleming, "The Measurement of High Frequency Currents and Electric Waves," (Lecture II.)

Farmers' Club, 5, Whitehall-court, S.W., 6 p.m. Mr. E. S. Beavan, "The Quality and Yield of English Malting Barley."

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Benjamin L. Bradley, "The Grindleford Stone Quarries and their Working."

Chemical Industry (London Section), Burlington-house, W., 8 p m. 1. Dr. W. A. Caspari, "Notes on Gutta Percha and Balata." 2. Dr. R. Seligman and Mr. F. J. Willott, "The Determination of Zinc in Zinc-Aluminium Alloys." 3. Dr. R. Seligman, "Distilled Water Supply for 'Works' Laboratories." 4. Mr. C. J. Dickinson-Gair, "The Estimation of Naphthalene in Coal Gas." 5. Messrs. Bernard F. Howard and F. Perry, "Salts of the Alkaloid Cinchonamine."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. H. Weld Blundell, "Exploration in the Abai Basin, Abyssinia."

British Architects, 9, Conduit-street, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Karl Pearson, "Variation in Man and Woman."

TUESDAY, DEC. 5...Designers, R.I.B.A. Galleries, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. Fred. Roe, "The Decoration and Construction of Mediæval Coffers and Cupboards."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. The Hon. Charles Algernon Parsons and Mr. George Gerald Stoney, "The Steam Turbine."

Pathological, 20, Hanover-square, W., 8½ p.m,

Photographic, 66, Russell-square, W.C., 8 p.m. Sir William Abney, "Three Colour Photography."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. C. Herman Senn, "Crystallisation of Fruit and Flowers."

WEDNESDAY, DEC. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Sigmund Stein, "The Manufacture of Sugar from British-grown Beet."

Geological, Burlington-house, W., 8 p.m.

Cold Storage and Ice Association, Caxton-hall, Westminster, S.W., 8 p m. Mr. Hal Williams, "Cold Storage Accommodation for Hotels, Butchers, and Provision Dealers."

Entomological, 11, Chandos-street, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. William Churchill, "The Nurhags of Sardinia, and some other Megalithic Monuments of the Mediterranean Region."

Obstetrical, 20, Hanover-square, W., 8 p.m.

Central Chamber of Agriculture, at the HOUSE OF THE SOCIETY OF ARTS, 11 a.m.

THURSDAY, DEC. 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Sir James Bourdillon, "The Partition of Bengal."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. Jonathan Hutchinson, "The Ætiology of Leprosy." 2. Mr. Arthur W. Allen, "Some Notes on the Life-History of *Margaritifera Panesece.*"

Chemical, Burlington-house, W., 8½ p.m. 1. Messrs. P. C. Ray and A. C. Ganguli, "The Constitution of Nitrates. Part I. Two Varieties of Silver Nitrite." 2. Mr. E. Divers, "The Products of Heating Silver Nitrite." 3. Messrs. W. P. Perkin, jun., and R. Robinson, "Ethyl Piperonylacetate." 4. Mr. F. D. Chattaway, "A Contribution to the Chemistry of Saccharin." 5. Mr. H. R. Le Sueur, "The Action of Heat on *a*-Hydrocarboxylic Acids. Part II." 6. Messrs. R. H. Picard, W. O. Littlebury, and A. Neville, "Studies on Optically Active Carbimides. Part II. The Reactions between l-Menthylbicarbimide and Alcohols." 7. Messrs. S. Chadwick, J. E. Ramsbottom, and D. L. Chapman, "The Action of Ultra Violet Light on Moist and Dried Mixtures of Carbon Monoxide and Oxygen."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Arthur Gulston, "Ice Breakers and their Services."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Dr. J. S. Owens, "Concrete Mixers."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. W. H. Patchell, "The Charing Cross Company's City of London Works."

FRIDAY, DEC. 8...Cyclists' Touring Club, (Metropolitan Section), at the HOUSE OF THE SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Lecture by Mr. Rumney.

Astronomical, Burlington-house, 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

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FRIDAY, DECEMBER 8, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 11, 8 p.m. (Cantor Lecture.) DR. J. A. FLEMING, F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (Lecture III.)

TUESDAY, DECEMBER 12, 8 p.m. (Applied Art Section.) LOUIS N. PARKER, "Historical Pageants."

*** The paper will be illustrated by Cinematograph Views of the Sherborne Pageant, kindly exhibited by Mr. Charles Urban.

WEDNESDAY, DECEMBER 13, 8 p.m. (Ordinary Meeting.) W. F. MITCHELL, "The Commerce and Industries of Japan."

THURSDAY, DEC. 14, 4.30 p.m. (Colonial Section.) HON. RODOLPHE LEMIEUX, K.C., Solicitor-General of Canada, "Glimpses of French Canada."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 4th inst., Dr. J. A. FLEMING, F.R.S., delivered the second lecture of his course on "The Measurement of High Frequency Currents and Electric Waves."

The lectures will be published in the *Journal* during the Christmas recess.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 6th, 1905; the EARL OF DENBIGH, C.V.O., in the chair.

The following candidates were proposed for election as members of the Society:—

Almond, Richard Pengelly, Balderton-house, Balderton, Notts.
Ballantine, James B., The Edison Ore-Milling Syndicate, Richmond, Surrey.
Barcroft, D. M., Croxteth, Baldoyle, Co. Dublin.
Bhore, John, Assoc.M.Inst.C.E., care of Messrs. Coutts and Co., 440, Strand, W.C.
Brown, George Gordon, 14, Beulah-hill, Upper Norwood, S.E.
Burford, Miss Evelyn Edith, care of Sir Boverton Redwood, 4 Bishopsgate-street Within, E.C.
De Nordwall, Charles F. 2, Observatory-gardens, Campden-hill-road, W.
Ellis, Clement Campbell, 82, Lancaster-gate, W.
Howard, Engineer-Captain George, Cantiere Odero, Sestri Ponente, Genoa, Italy.
Parrott, Joseph, 3, Wellington-street, Stockton-on-Tees.
Picard, John, 9, Vicarage-gate, Kensington, W.
Whitehead, Thomas, Brindle-lodge, near Preston.

The following candidates were balloted for and duly elected members of the Society:—

Charlesworth, Samuel, Prescott, Uffculme, Cullompton, Devon.
Clarke, Thomas Ernest, The Laurels, 12, Ravenslea-road, Wandsworth-common, S.W.
Diekmann, Hermann, 13, Dulwich-wood-park, S.E.
Glenday, Robert, Assoc.M.Inst.C.E., Government-buildings, Bloemfontein, Orange River Colony, South Africa.
Hebditch, William E., Messrs. Eyre and Spottiswoode, East Harding-street, Fetter-lane, E.C.
Hooper, William Harcourt, 5, Hammersmith-terrace, W.
Ingram, Herbert P., 26, Rowlandson-terrace, Sunderland.

The paper read was—

THE MANUFACTURE OF SUGAR FROM BRITISH GROWN BEET.

By Sigmund Stein.

The question we have to discuss to-night is not new to many of you. You have read from time to time opinions expressed in the daily papers, commercial journals, and technical periodicals, about the possibilities of growing sugar beetroot in this country, and using it for the manufacture of sugar. The question has been ventilated *pro* and *con* in many quarters, and discussed very widely in commercial, agricultural and financial circles. The question has also been brought up repeatedly in the House of Commons, and our Government have had to give some attention to the problem.

In coming before you to-night, I beg your indulgence and your patience in dealing with a subject which has not up to the present moment found enough sympathy in all quarters such as to obtain early realisation. The question of growing sugar beetroots on a large scale, and the home manufacture of beet sugar remains up to the present moment but a pleasant dream which after we wake proves nothing but an illusion. If you would ask me the question:—"Tell us why we do not grow our own sugar-beet and make our own sugar?" I should then know that you take an interest in this matter. How is it that we, still the cleverest nation in the world, the nation of political economists, the country where money is found as it were in the street, the country which prides itself in being the world's banker, the country which has certainly the cleverest and shrewdest agriculturists, the country which consumes the greatest quantity of sugar, does not produce a single ounce of it? Just consider this carefully: the country which is the greatest sugar consumer does not produce a single grain. I venture to give you, in the following enunciations, the reasons of this, unpalatable as they may appear:—

1. Because we lack courage.
2. Because we choose to be behind the times.
3. Because we wish to have the question of agricultural depression before us day after day.
4. Because we do not wish to settle the question of the unemployed.
5. Because we do not wish to improve our soil and our agriculture.
6. Because we would rather see foreign industries flourish, and import foreign manufactured goods, instead of patronising home-made goods.
7. Because the question was criticised by people who had no idea about beetroot growing, by people who have never seen a beet field, nor a beet factory, and who have no technical experience in beet sugar making or refining.
8. Because for a long time Great Britain was not considered a country suitable for beetroot growing; it was too wet, too dry, had too little sunshine; and all kinds of climatic disabilities have been thrown in the face of the prospective British beet sugar industry.

Yet how times have changed during the last fifteen years. What an enormous improvement in our weather has taken place! All these sceptical reviewers and critics have now become silent on this point. They seem to have discovered so much sunshine, such enormous improvements in the climatic conditions generally, and they have unanimously come to the conclusion that: "we can grow quite as good beetroots, if not better, than our Continental competitors."

The question is settled after many years of talk, that our climate and country are suitable for beetroot growing. I am very glad for this victory, for which I have worked for so many years, devoted so much of my time and a great deal of money, all of which have caused me very much trouble and anxiety, in persuading my fellow countrymen of the feasibility of growing beetroot.

We will now discuss the several aspects of the problem. There is first:

The Labour Question.

Now that the most important question is settled, another has arisen, namely, can we find enough labour in this country, and if we can find it, how much would this labour cost us? Really it is a very reasonable question. I have written pamphlet after pamphlet regarding the matter, and I have inquired in all parts of the country about the quantity of labour to be got there and the prices paid to the labouring classes, and I have the entire satisfaction of knowing that sufficient agricul-cultural labour could be obtained in this country, and that the wages would not be any higher than on the Continent of Europe. I had the utmost satisfaction in this respect when I took a party of gentlemen from England to the Continent, and enabled them to inquire for themselves into the cost of labour there, and they were perfectly satisfied that we here in England had the same advantages with regard to labour as the people on the Conti-

nent. The report they brought back with them lies before me now on the table, and they say that "the cost of labour on the Continent is not any lower than here in England." If any gentleman doubts me I can prove to him on the best authority that my statements are correct.

Does anyone doubt that we can find enough labour, not only to work one or two factories, but to work hundreds? Do we not hear the heart-rendering cries of the hungry and the unemployed, and could our Government take a wiser step or find a better remedy than by settling the question of the unemployed, and giving the homeless and starving creatures work in a permanent and healthy channel, than by means of the indigenous sugar industry?

I am not a professional political economist, but so far as my knowledge in political economy extends, I can see and realise that much shortsightedness exists in certain quarters. Yet we should bear in mind that charity begins at home: let us see that our fellow citizens have got bread, and if they have it we shall have satisfaction in everything, satisfaction in regarding the condition of health and mind, and knowing that we are bringing up a healthy future generation.

I have experimented for many years in growing sugar beetroots practically in every county in England, Scotland, and Ireland. I have proved by nearly 2,500 experiments that we in this country can grow better beetroots than they can on the Continent, and more tons per acre than our Continental competitors.

Beetroots can be grown nearly everywhere, on almost every kind of soil. The beet is a plant which grows very patiently, and can endure great hardship. The cultivation is not difficult, as my experiments with many hundreds of farmer friends have proved. My instructions for growing beetroots have been sent broadcast into the remotest corners of our country. I have been able to record yields of 40 tons of roots per acre, but the general average for all these years amounts to about 17 tons per acre. Regarding the saccharine strength of the roots, I have found roots in England showing as much as 21 per cent. of sugar, but the average is about 17 per cent., which compares very favourably with the sugar content of the Continental grown roots.

I have been invited lately by different farmers' societies, various chambers of commerce, and county and town councils, to lecture on this subject and to express my views. I have always found the farmers very willing to take up the cultivation of sugar beetroots, if they could find a factory which would contract with them for a number of years. The farmers are very anxious to grow sugar beetroots, because they have found out after several years' experiments that after calculating the cost of cultivation and all other necessary expenses, the yield per acre of roots would give them a very handsome profit, if they could receive for their beets as much as 18s. per ton. I issued a few years back a balance-sheet for the beet-growing farmer, a document which was criticised on all sides. But, you will always find some people in this world who are very glad to be over-sceptical, and who have always ready a bucket of cold water to throw on any scheme of which they have no knowledge, and which is not in sympathy with their own ideas. They criticised my balance-sheet, saying that I had put the expenses of sugar beet-growing too low. I disputed the point with them and said that they were wrong and that I was right, but they still stuck to their views. But, after many years' struggle, I am now in the happy position (and I am supported by many great land-owners and agriculturists, and by many people who have grown sugar-beet experimentally for a considerable number of years) not only to be able to maintain the cost I gave for the cultivation of sugar-beet, but, what is more, I have now to reduce it, and I give you below a new and revised balance-sheet for the beet-growing farmer.

First, let us have the estimate of the expenses to be incurred:—

COST PER ACRE OF GROWING SUGAR BEETROOTS.

	£	s.	d.
Rent and taxes	1	0	0
Clearing and forking weed stubble	0	1	0
Ten loads farmyard manure	1	5	6
Carting 10 loads fresh manure	0	5	6
Spreading manure	0	1	0
Ploughing 8 to 10 inches deep	0	8	0
Cultivating, including harrowing and rolling	0	6	0
Artificial manure	1	10	0
Sowing	0	2	6
Seed (20 lbs. at 4d.)	0	6	8
Drilling	0	1	0
Hoeing and thinning	0	10	0
Harvesting crop	0	10	0
Carting to factory 15 tons 3 miles, at 6d. per mile and ton and 3d. per ton labour	1	6	3
Total	£7	15	5

I expect there will be some strong dissent offered when this new and revised estimate of the cost of beet cultivation is made public, but I am prepared to maintain its accuracy. Now we will turn to the balance-sheet :—

BALANCE-SHEET OF THE BEET-GROWING FARMER.

Dr.	£ s. d.	Cr.	£ s. d.
Cost per acre to plant, cultivate, harvest, and deliver roots ...	7 15 5	Receipt for roots, 15 tons at 18s. ton ...	13 10 0
Extra carting to the factory for 15 tons roots...	1 10 0	Value of 5 tons leaves and heads from roots...	1 5 0
Profit per acre	7 4 7	Three tons slices (20 per cent. of quantity delivered) at 10s. ...	1 10 0
		Value saturation lime (free from factory)	0 5 0
Total	16 10 0	Total	16 10 0

You see by this balance-sheet there remains a considerable profit, which in any case leaves a good margin for discrepancies. I took, as a minimum crop, 15 tons of roots per acre. I also credited the farmer with five tons of leaves and heads from the roots. The roots are headed on the top, and a considerable piece is cut off; this part is the poorest in sugar, but the richest in salts, and so is not practicable for manufacturing purposes, but it is a very good cattle food, the leaves being also very good for the same purposes, and they remain with the farmer.

When the roots are used for manufacturing purposes, they are cut into small slices, like vermicelli. These slices are diffused with hot water, and the sugar nearly all extracted. After the slices have been exhausted of their saccharine contents, they are removed from the factory, pressed out, and then sent back to the farmer, and he finds in them a very valuable cattle food. If you consider that the beetroot contains 80 per cent. of water, and the pressed slices about 30 per cent., you will see that the food value of these slices is very much superior to the beetroots, but, of course, you have abstracted from them the saccharine matter. These slices are given to the farmer partly free, and partly charged for. You see I credit the farmer with three tons of free slices. The farmer also receives a quantity of lime which is used in the manufacture of sugar, and is called "saturation lime;" it proves a splendid manure, because you find in it many ingredients of great manuring value.

THE FOREIGN SUGAR BOUNTIES.

As long as we can remember, there have been, until just lately, sugar bounties, or grants, given by foreign Governments to the Continental sugar manufacturers on the export of their sugars. By the Brussels Convention these bounties ceased from the 1st of September, 1903. As long as they existed there was practically no chance of our growing sugar beet to manufacture sugar therefrom. These sugar bounties are now things of the past, and

FIG. 1.

SUGAR BEET. VILMORIN (à collet rose).

it is safe to say they will never be revived again.

Our Government insisted on the sugar bounties being abolished so as to ensure free trade in the world's sugar market, and to make it possible in this country to grow sugar beetroots and manufacture beet sugar therefrom. We have done everything now to bring the sugar bounties to a well merited end, and yet we have, up to the present, not taken any

steps to establish a home sugar industry. Why have we struggled for so many years to get the bounties abolished, and now when they are done away with, why do we sit idle on the fence? By the Brussels Sugar Convention, the nine contracting parties agreed, that, the difference between the home consumption tax and import duty must not exceed six francs per hundred kilo, or 2s. 6d. per cwt. on refined sugar; that means to say, the sum of 2s. 6d. per cwt. remains still to the credit of the Continental sugar manufacturer. Now England is a party to this Convention, and has signed it and promulgated it by Act of Parliament. As you are aware, we are saddled at the present time with a sugar tax. This sugar tax, while nominally an excise tax, is, for all purposes, simply an importation tax, or Customs duty, because we import sugar, we do not produce it As you know, it amounts to 4s. 2d. per cwt. on refined sugar. Now I claim that as we are a party to the Brussels Convention, the British sugar manufacturer has a perfect right to the same advantages as the Continental manufacturer; that means to say in plain English that as the sugar tax is 4s. 2d. per cwt. home manufactured sugar should only pay 4s. 2d., minus 2s. 6d., which equals 1s. 8d. per cwt. In theory this right cannot be disputed, but its adoption will have to be part and parcel of the scheme of tariff reform which so many desire to see introduced into this country, because it involves preferential treatment. We must therefore hope that the country will at an early

Fig. 2.

Sugar Beet. Vilmorin. (Brabant.)

date give its Government a mandate to put in force the privileges to which the British beet farmer is entitled from the provisions of the Brussels Convention.

Different Schemes at present Brought Forward.

Since I started my campaign for the establishment of beet sugar factories and the growing of beetroots, and commenced publishing annual reports, instructions, and pamphlets, many gentlemen have taken the matter up and suggested different schemes. I am most thankful to these gentlemen for their goodwill, but I am afraid that the statements which they have brought forward and published in different papers are not quite correct, and I am sorry to say are in some cases very misleading, and tend to do more harm than good. Just while preparing this paper I received information regarding a scheme which, to say the least of it, was too ridiculous to entertain and criticise. The originator of this scheme has not the faintest idea regarding the *modus operandi* of this industry, and I do not think it would be possible for his proposals to be realised in the twentieth century. You will excuse me if I do not here go into details, I only want to warn you not to be taken in by such highly coloured schemes, for they are like structures of cardboard which fall to pieces if only slightly disturbed. We had two sugar factories here in this country before, and they failed, and we must prevent another such failure taking place, by looking after the erection, the management, and all the different conditions which belong to such an undertaking. When a sugar factory is started in England it must be done on purely commercial lines, well founded, and all the details well worked out beforehand, such as concern a good supply of roots, good roads or other means for transportation, plenty of water, and good management (commercial and technical). Only under these conditions can we look forward to the first factory being the nucleus of scores of other factories which would have to be erected to cover our demand for sugar, and to make us independent of foreign countries.

Fig. 3.

Sugar-Beet. (Klein-Wanzleben.)

Extent of Sugar-beet Growing.

Sugar-beet is grown in all countries of Europe; in Germany, Austria, Hungary, France, Holland, Belgium, Russia, Switzerland, and Denmark. Even countries as far north as Sweden, and South European coun-

tries, like Spain, cultivate beet. Italy, Servia, Roumania, Bulgaria, and Greece have well-established beet factories. Eastward the beet cultivation exists as far as Persia and Siberia. It has also been tried in Manchuria, Australia (Victoria), and America (Canada and United States).

The United States produced a few years ago only a few thousand tons of beet sugar: to-day their production amounts to about 265,000 tons per annum.

We also find sugar-beet culture carried on in Chili. I myself have tried successful experiments in Natal, and also in Barbados and the East Indies. I received a communication a few days ago from the Cape regarding the inauguration of the beet-sugar growing industry out there. You see, gentlemen, that the sugar-beet is a plant growing practically everywhere where civilisation exists.

Fig. 4.

Sugar Beet. (Vilmorin-White.)

Process for Manufacturing Sugar.

The factories I have in view to be erected in our country are to produce refined white sugar (granulated, crystals, and cubes) direct from the beetroots without the aid of animal charcoal, simply by my process, "the Stein process of refining without charcoal."

I submit to you in the following lines the way in which this refined sugar is manufactured direct from the beet:—

1. The beetroots are carted by the farmer to a shed in the factory.

2. The beets are next sent to the washing

machine where they are freed from the adhering earth and dirt. (Fig. 5.)

3. After washing, they are lifted by an elevator to the beetroot slicing machine. In this machine (which contains a special form of knife) the beetroots are cut into small slices like vermicelli. (Fig. 6.)

4. These slices are put into large cylinders technically termed "diffusers" (Fig. 7). Twelve to fifteen diffusers are placed in a circle or in two rows, and the sugar contents extracted from these slices with tepid [water under pressure. This process is now so perfect that only about 0·2 per cent of sugar will remain in the exhausted beetroot slices. These slices are placed in the press, where they are freed

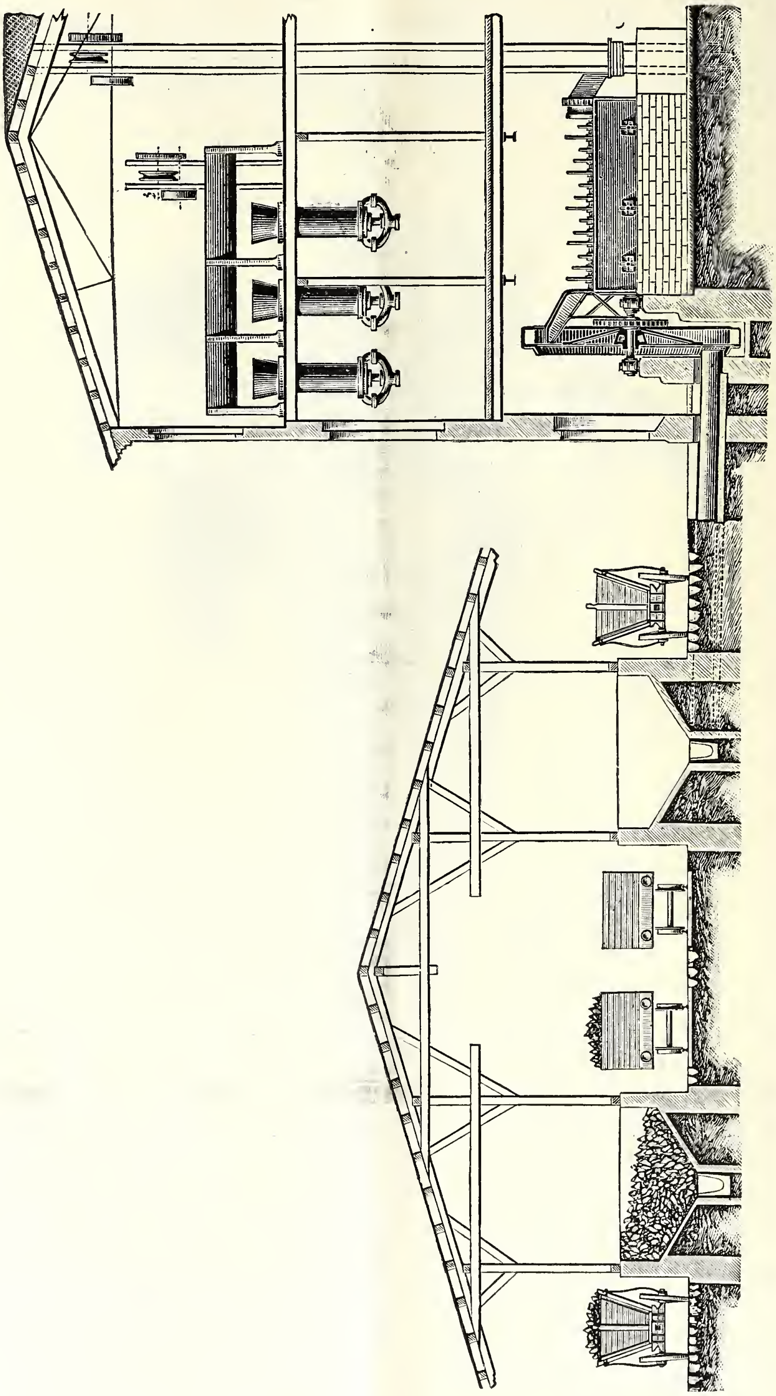


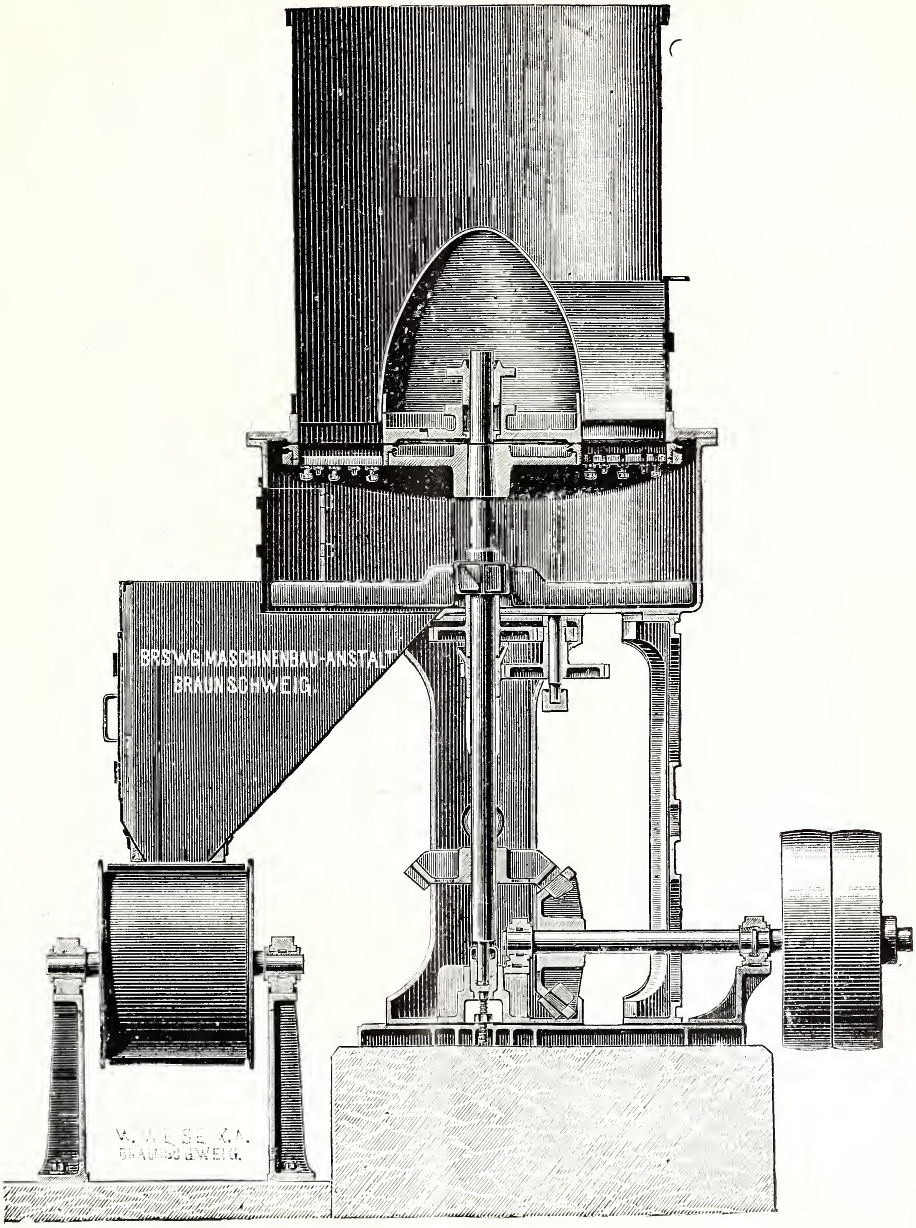
Fig. 5.

Beet Washing Station.

from the greater quantity of water they contain. (Figs. 8 and 9, p. 79.)

5. The sugar liquor extracted from the slices is called "raw juice," and this immediately becomes black on exposure to the atmosphere.

Fig. 6.



Beet Slicing Machine.

The raw juice is put into a vessel and treated with abont 2 per cent. of lime. This lime process removes the organic impurities which the raw juice contains. After this, carbon dioxide is pumped into the limed juice. The lime is then precipitated, and forms carbonate of lime, whereupon the sugar liquor becomes bright, yellow and clear. This process is called "Saturation." (Fig. 10.)

6. The precipitate formed is separated from the liquor in a filter press (Fig. 11, p. 81), and the carbonate of lime remaining in a cake is used as manure, and is called "saturation lime."

7. The liquor is subsequently treated in a

similar way with equal quantities of lime until all the organic impurities are removed.

8. After the last saturation, the liquor is again filtered and treated with sulphurous acid (SO_2). A further filtration removes the sulphide of lime which this treatment has produced.

9. The clear liquor which runs off from this last filtration is called "thin liquor," and gauges 5° to 8° Bé. It is then evaporated in a specially arranged series of vacuum pans to a concentration of 28° Bé. (Fig. 12, p. 82.)

10. The "thick liquor" is now submitted to the "Stein process of refining," which is a

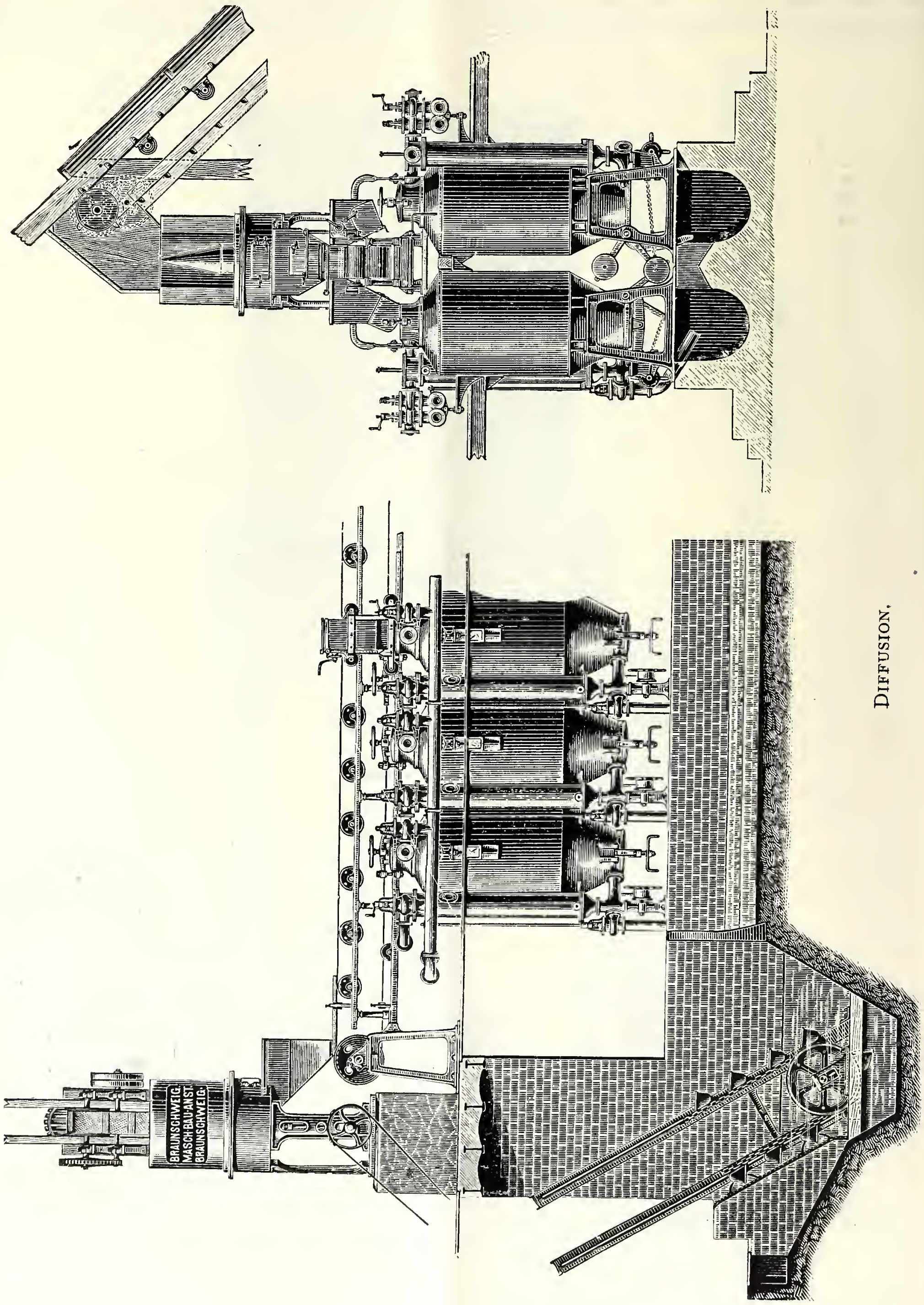


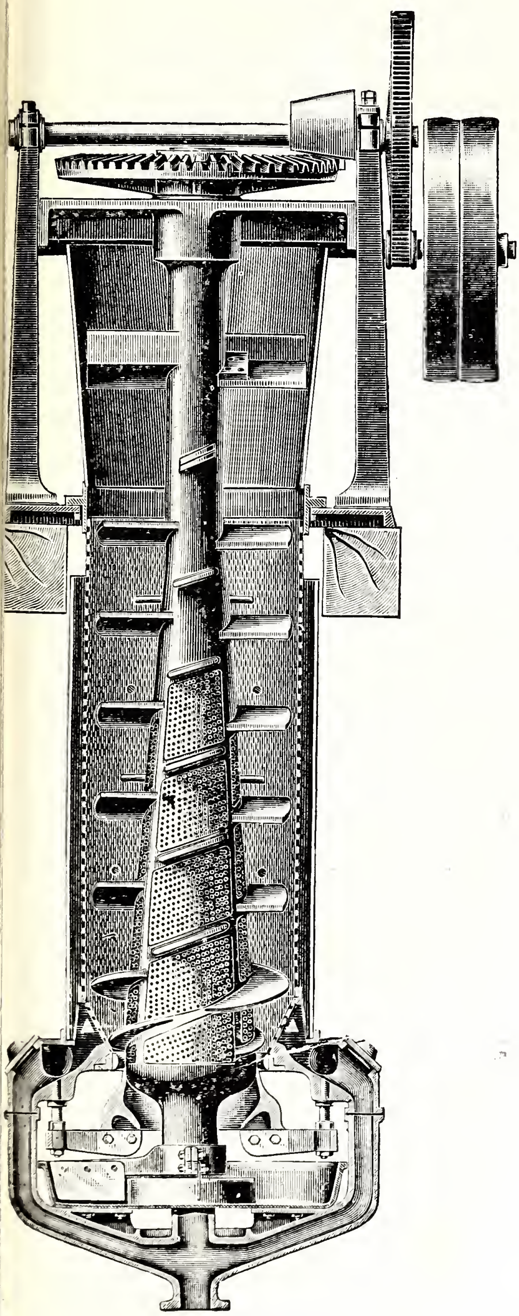
FIG. 7.

DIFFUSION.

systematic treatment of the liquor to get rid of all impurities.

11. This thick liquor so prepared is boiled to crystals in the ordinary boiling vacuum pan,

FIG. 8.

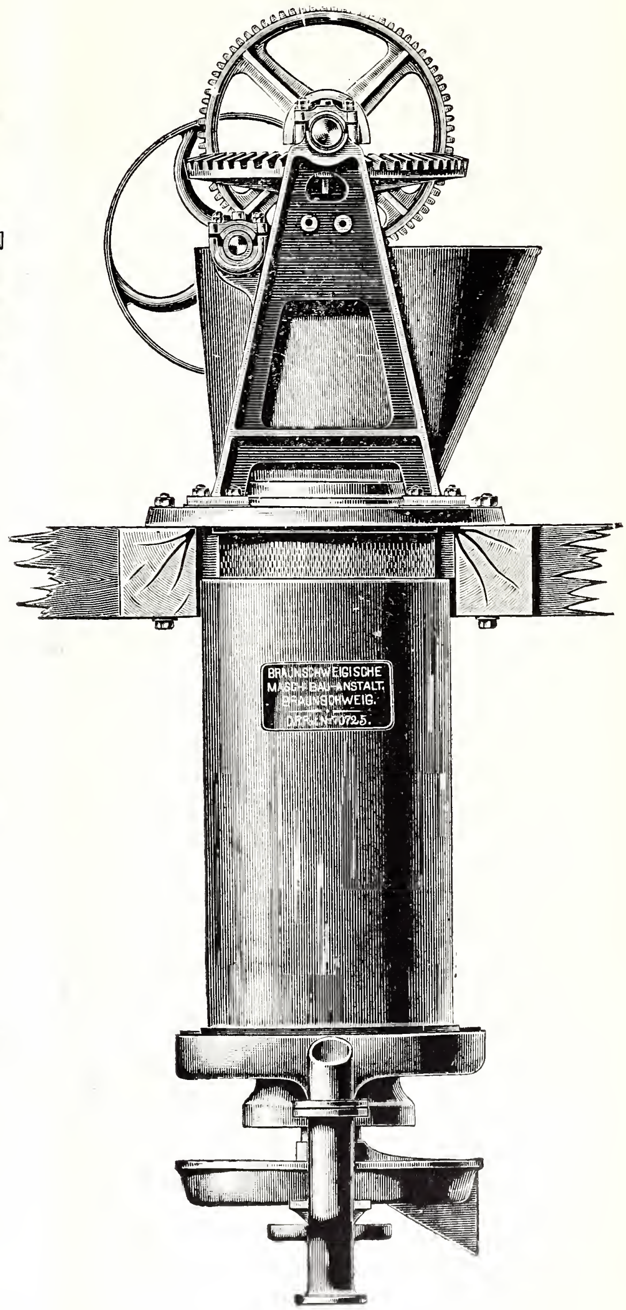


SLICE PRESS.

and the contents are called "massecuite." This massecuite contains the sugar crystals floating in a syrup or mother liquor. (Fig. 13, p. 83.)

12. The crystals are separated from the mother liquor in a centrifugal machine, and are treated there according to "Stein's method of manufacturing sugar" direct in the centri-

FIG. 9.



SLICE PRESS.

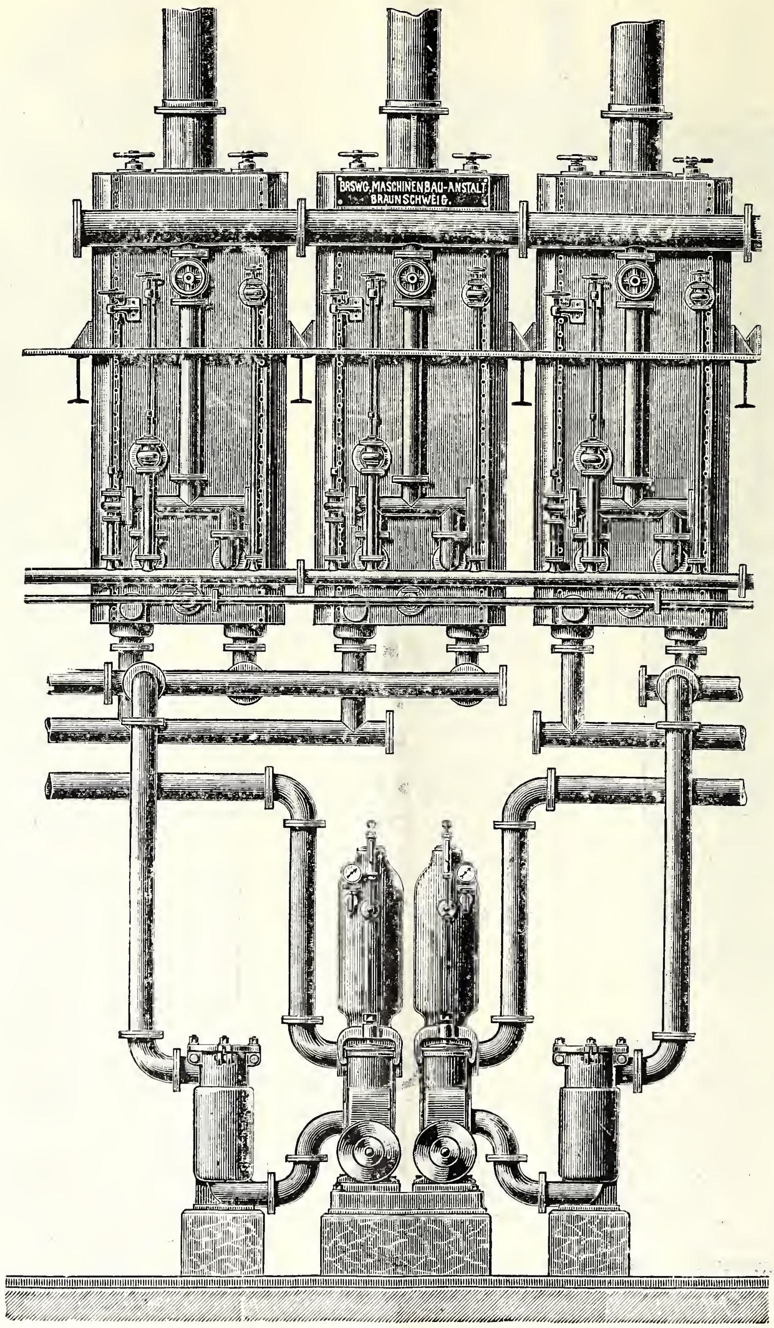
fugal machine, either for granulated, crystals or cubes. (Fig. 14, p. 84.)

13. The final product (granulated, crystals or cubes) is put into a drying stove, or Stein's

drying apparatus, and after drying, is ready for packing and consumption.

You see the process is a simple and systematic one, and involves very little expense without passing it through a refinery. The British beet-sugar factory should be a refinery in itself, to work without charcoal and save thereby about 30 per cent. of the expenses.

FIG. 10.



SATURATION.

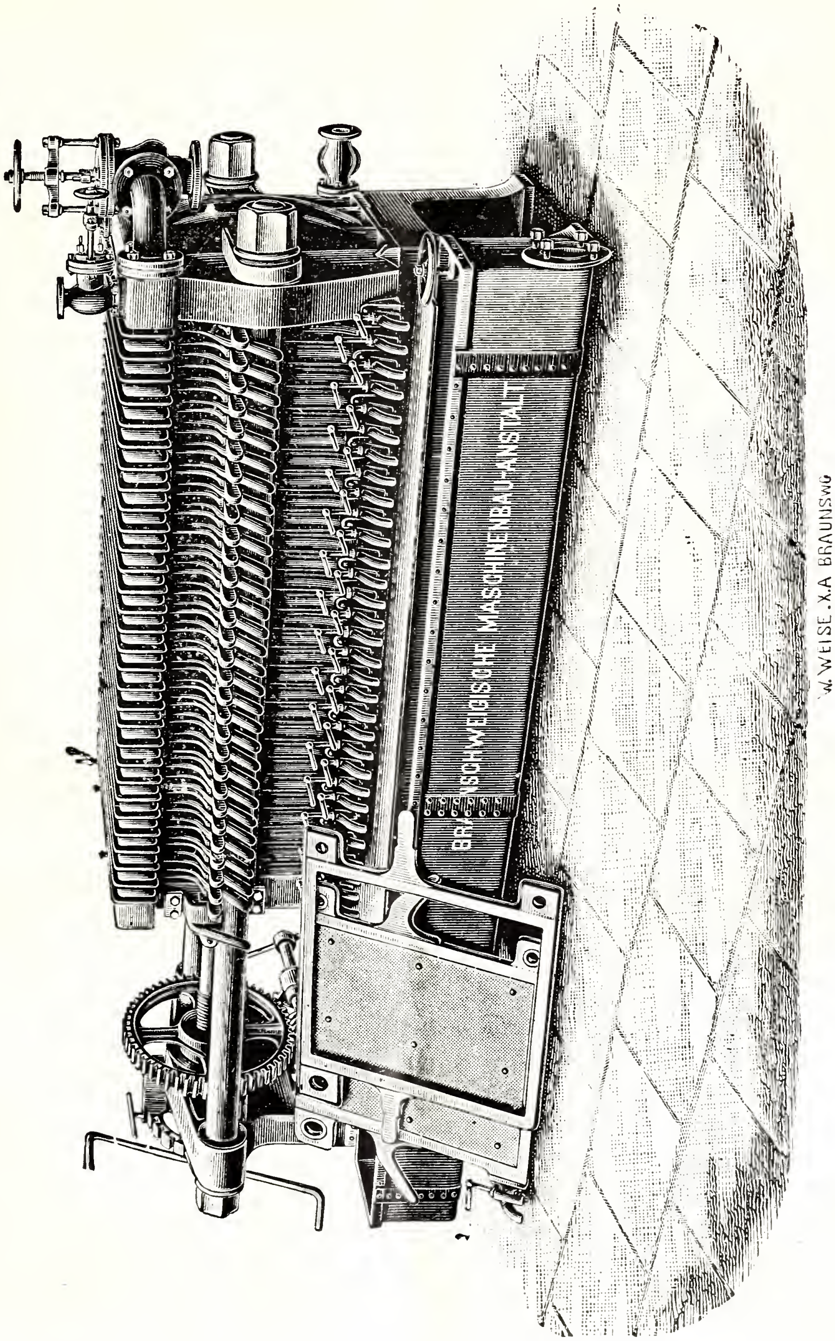
indeed; and there you see lies the advantage of the British sugar maker, to refine sugar for consumption direct from the beetroots

PRICE OF SUGAR.

It is a most inopportune moment to speak about sugar-beet growing in this country,

or the erection of beet-sugar factories, now that the price has got to a point which is a record in regard of lowness. Sugar has never been so cheap as long as sugar has been known. The tragic crash and failures in the sugar market in Paris have had the effect of carrying prices below anything ever known before, and it is now fair to expect that the reaction will take place very soon. The present reduced price will surely increase consumption, and apart from that there will be an enormous increase in the distribution of sugar in all the trade channels of the world. The peculiar conditions prevailing in France have helped to bring about the panic in the market, the influence of which is felt now in a great

Fig. 11.

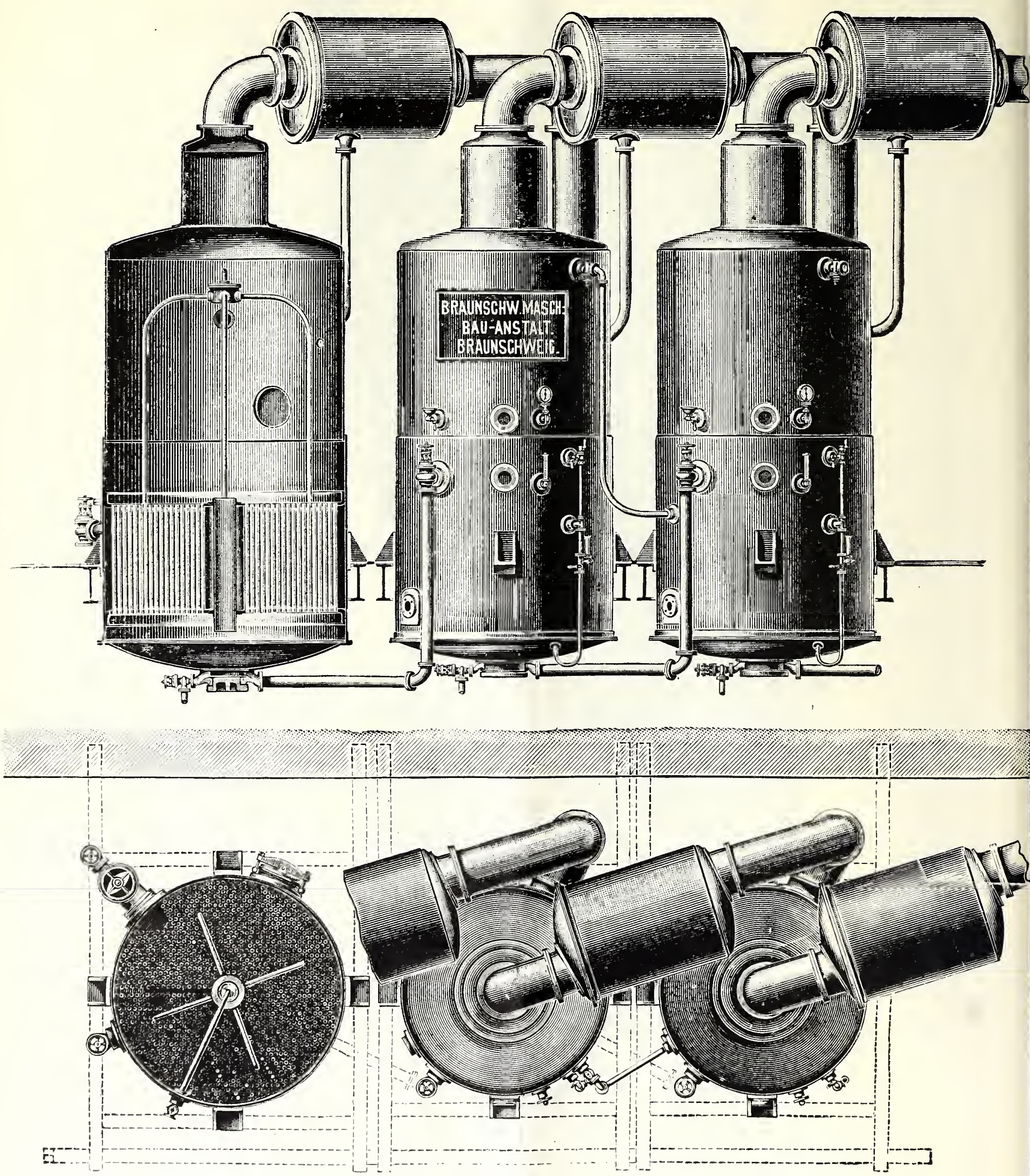


Filter Press.

degree. It is generally admitted that there has been a great exhaustion in the invisible supply of sugar throughout the world, because of the small crop in Europe last season, which is smaller than it has been for many years. As soon as the sugar prices become settled at any particular level there will unquestionably be a very material increase in the demand for sugar, and such an increase will lead to very much higher prices than are at present prevailing.

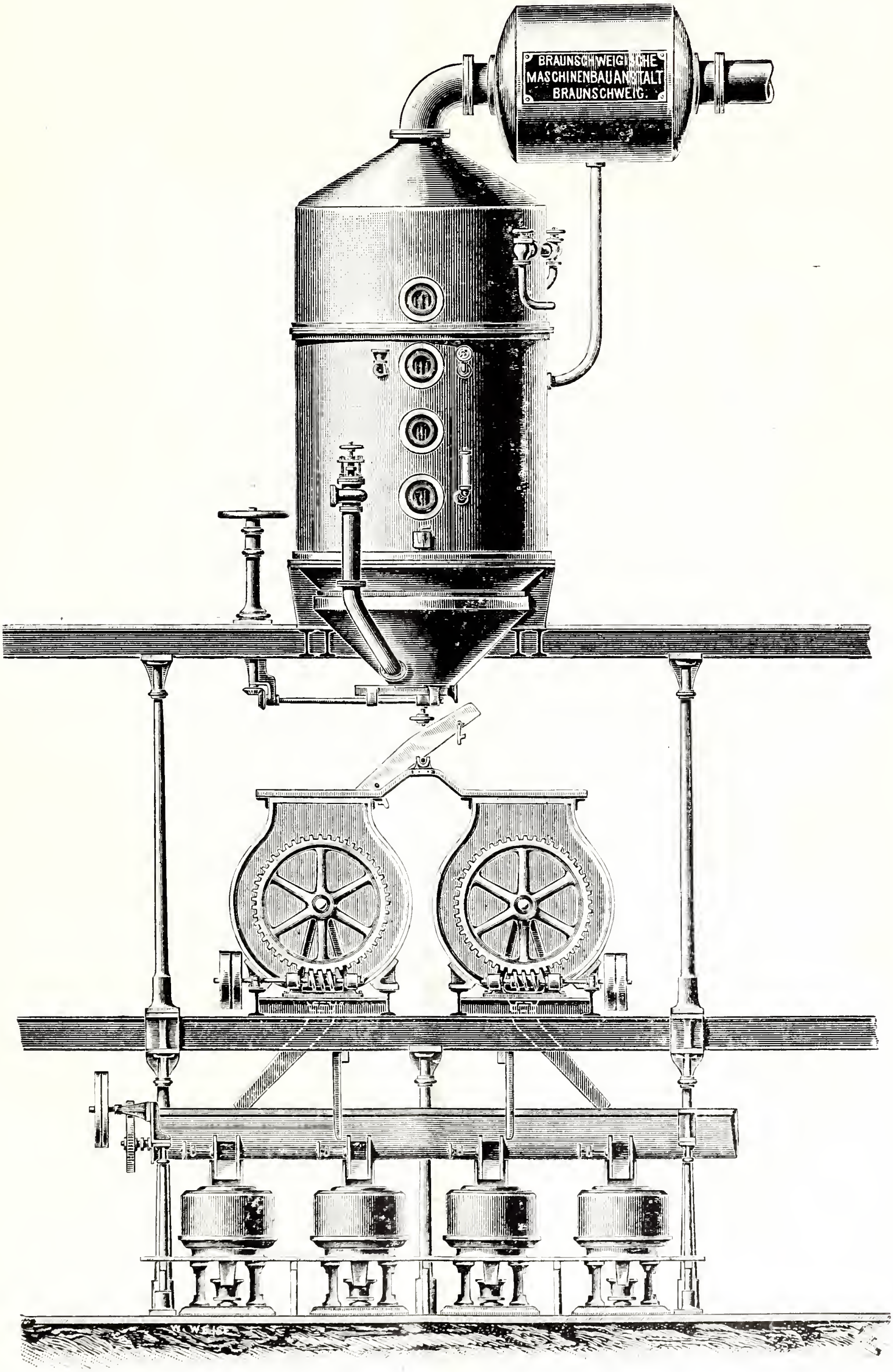
The estimate for the new beet crop has appeared, and is a very heavy forecast. There will be some difficulty in financing such a quantity of sugar this season, as the value of sugar, therefore, for forward delivery, say, for

FIG. 12.



EVAPORATOR.

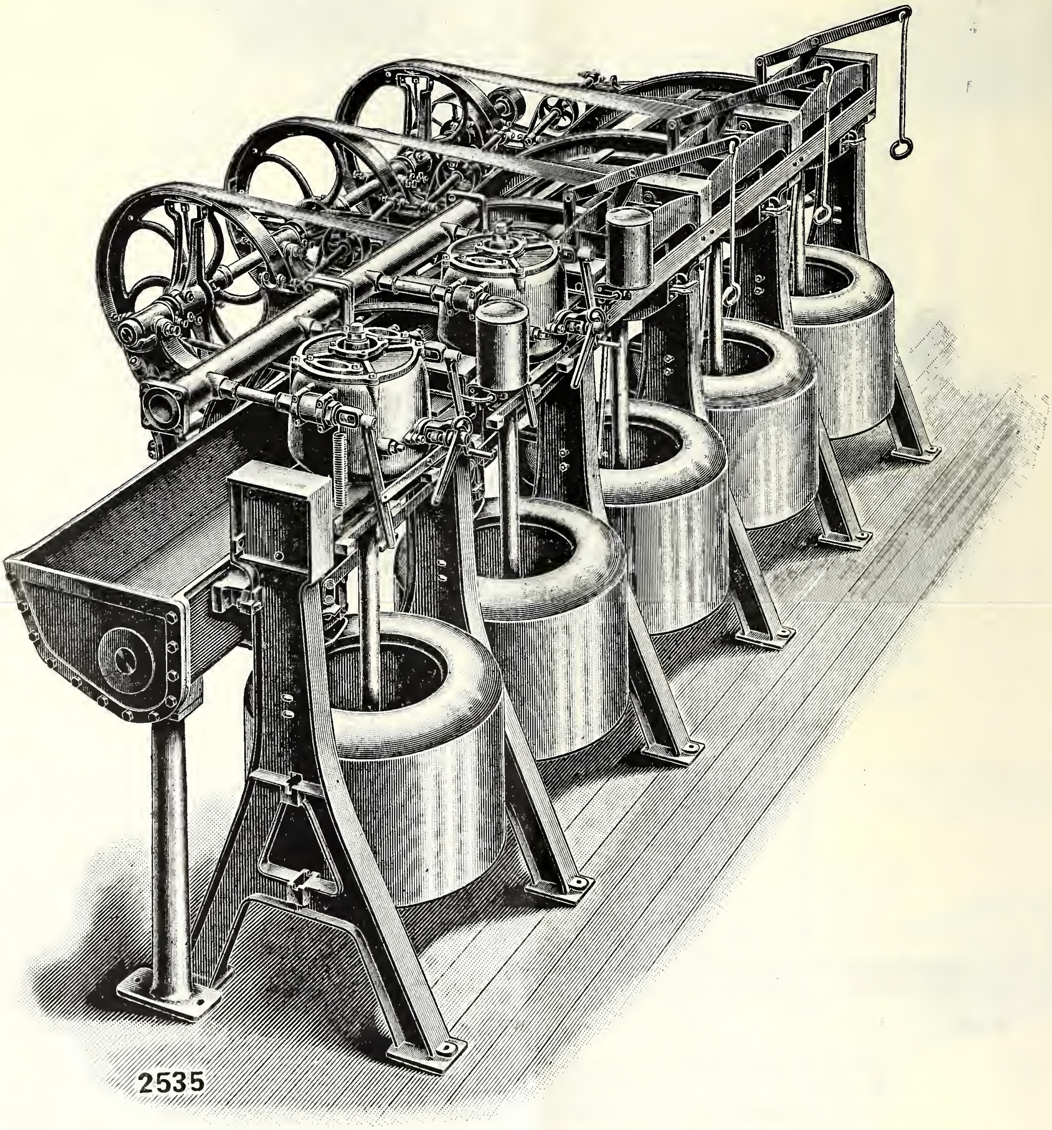
FIG. 13



VACUUM PAN WITH MIXER AND CENTRIFUGALS.

the summer months of 1906, shows a great premium. If the price of sugar only remains low for the next two or three months, there will certainly be a curtailment in the sowing next year, and this will result in advance of prices. Beet-sugar is at present at a price much below production, and the present cheapness must inevitably lead to a great increase in the consumption here and on the Continent. It is possible therefore that the fabricants on the Continent will prefer to store their sugar to provide for the growing wants of their customers. Should the financial support be sufficient to carry the immense supply of beet and cane sugars, there is no reason why the prices should not improve considerably. There is no fear that the prices will remain for long as they are now, and I give you the following reasons why sugar must go up considerably:—

FIG. 14.



WATER-DRIVEN AND BELT-DRIVEN "WESTON" CENTRIFUGAL MACHINES.

1. The large crop is not yet at hand. Not only will the regular transport be seriously affected by the continental rains, and thus considerably add to the risk of damage from frost, but also the analysis will suffer, and, as a consequence, considerable modification of the estimates may result.

2. The large crop is already discounted in

the prices. It is a well-known fact that the present price is below the cost price, taking into consideration the prices paid for the roots. The consequence will be that the manufacturers after having delivered their sugar sold, will store the remainder, waiting for better prices.

3. It is striking that again no notice is taken of the replenishment of the consumed invisible stocks, whereas last year the existence of these invisible stocks was not taken into account. This year, the replenishment of the invisible stocks will absorb a considerable part of the surplus.

4. At these low prices, the sowing of beetroots must decrease very much. This will be especially the case in Germany, as in February, 1906, the corn import duties will be greatly increased, and the farmers consequently need not accept any price offered for the beetroots.

5. The high prices at the beginning of this year have caused sugar to be exported from countries which will not export at the present low prices.

THE FALL IN SUGAR PER CWT. SINCE JANUARY, 1905.

From the *Produce Markets' Review*.

1905.	1st Marks Granulated.	Foreign cubes.	Tate's cubes.
January 1 (highest point)	0 17 9¾	1 0 3	1 5 10½
February 1	0 17 7½	1 0 3	1 5 10½
March 1	0 16 9	0 18 9	1 5 1½
April 1	0 16 3¾	0 18 7½	1 4 6
May 1	0 14 10½	0 17 9	1 3 6
June 1	0 13 10½	0 16 4½	1 2 4½
July 1	0 13 1½	0 16 0	1 1 10½
August 1	0 12 6	0 15 3	1 1 7½
September 1	0 11 4½	0 14 0	0 19 10½
October 1	0 10 8¼	0 13 3	0 19 10½
November 1	0 9 10½	0 12 3	0 19 1½
Fall from highest point	0 7 11¼	0 8 0	0 6 9

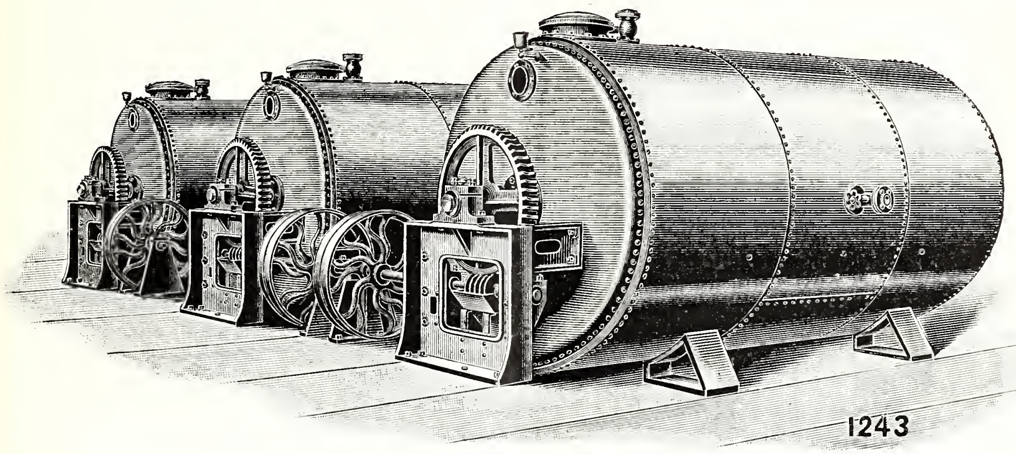
In my previous publications I have mentioned the advantages which the introduction of sugar-beet growing, and the erection of sugar-beet factories, would bring to the English manufacturer, farmer, merchant, tradesman, and professional man, to the English railways, the English engineers, and to many other professions and trades. In short, I have pointed out how beet cultivation would increase the wealth of the country. I showed:—

1. How beet culture improves agriculture.

2. How beet culture produces manure for the land.

3. How beet culture improves the farm stock.

FIG. 15.



CRYSTALLISATION IN MOTION.

4. How beet culture is the great question of the day from the standpoint of political economy.

5. How we may find employment for a great portion of our population.

6. How we can supply the British farmer with a valuable cattle food in the form of pulp.

7. How the British farmer would find it to his advantage to grow beet instead of wheat or potatoes or other agricultural produce, seeing that the profit to be derived from the beet cultivation is many times higher than if he grew anything else.

8. How sugar-beet compares very favourably with mangolds. I have published statements in which I have shown that the profits from growing sugar-beet are exactly double those when mangolds are grown.

In spite of all these advantages for sugar-beet growing and for the erection of beet-sugar factories, a start has not yet been made in this

country to grow sugar-beet on a large scale and to manufacture the beet into sugar. Nobody, whether a capitalist, financier, sugar merchant, confectioner, jam maker, or anybody else interested in the erection of beet-sugar factories, would put a penny down for the prospective sugar factory if they did not see beforehand that the invested capital would be a sure and safe investment for their money. Everybody is his own finance minister. Everybody first for himself, then for his fellowmen, and finally for the community in general.

I give you below the cost of producing refined sugar direct from the beetroots, and I also give you a balance-sheet of a prospective beet-sugar factory to convince you decisively that it would pay to manufacture beet-sugar. I give you the following advantages which we have over our continental competitors :—

1. We can grow more roots per acre.

2. We can grow richer roots than on the Continent.

3. We have the consumption at hand, being the greatest sugar consumers in the world.

4. We save freight.

5. We save commission, as the factory sells direct to the consumer.

6. We can make use in the new installation of the latest improvements in cultivation and manufacture by having at our disposal the best implements and machinery.

7. We can manufacture in the prospective works refined sugar direct at a very low price.

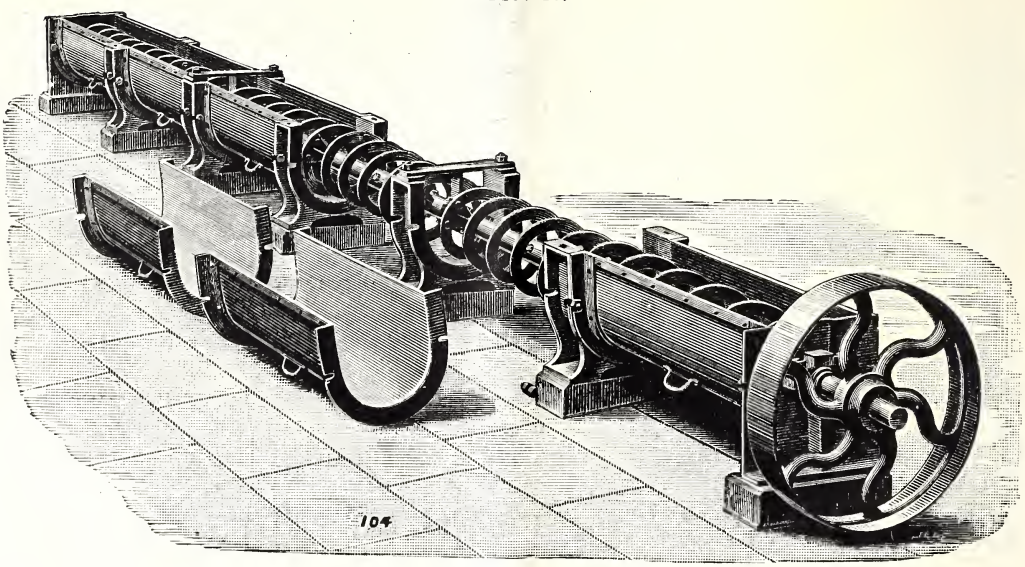
8. We can employ the plant of our works in the summer months, after the campaign is over, much better than the factories can do on the Continent, as we have many other industries in this country which could be well carried out in this factory.

Cost of Producing Refined Sugar from Beetroots.

		£	s.	d.
Fuel: 12 per cent.; coal at 10s. 6d. per ton		0	1	3
Wages:—				
First process (preparative)		0	0	8
Second ,, (complete)		0	0	10
Third ,, (refining)		0	0	7
Limestone 4 per cent., at 6s. per ton—delivered		0	0	3
Coke	2·30d.			
Leather and filtercloth	·60d.			
Bags	1·92d.			
Oil and grease	·55d.	0	0	9
Light	·45d.			
Various materials	·62d.			
Laboratory	·56d.			
Selling commission	2·0d.			
Price of beetroots per ton		0	18	0
Sundry expenses		0	0	3
Expense of offices, management, &c.		0	2	5
		£1	5	0

So you see, calculating the beetroots at 18s. per ton, the whole cost of manufacture, including all expenses of office and management, would be 7s. per ton of beetroots. I now give you the balance-sheet of an English beet sugar factory. I must say at once that

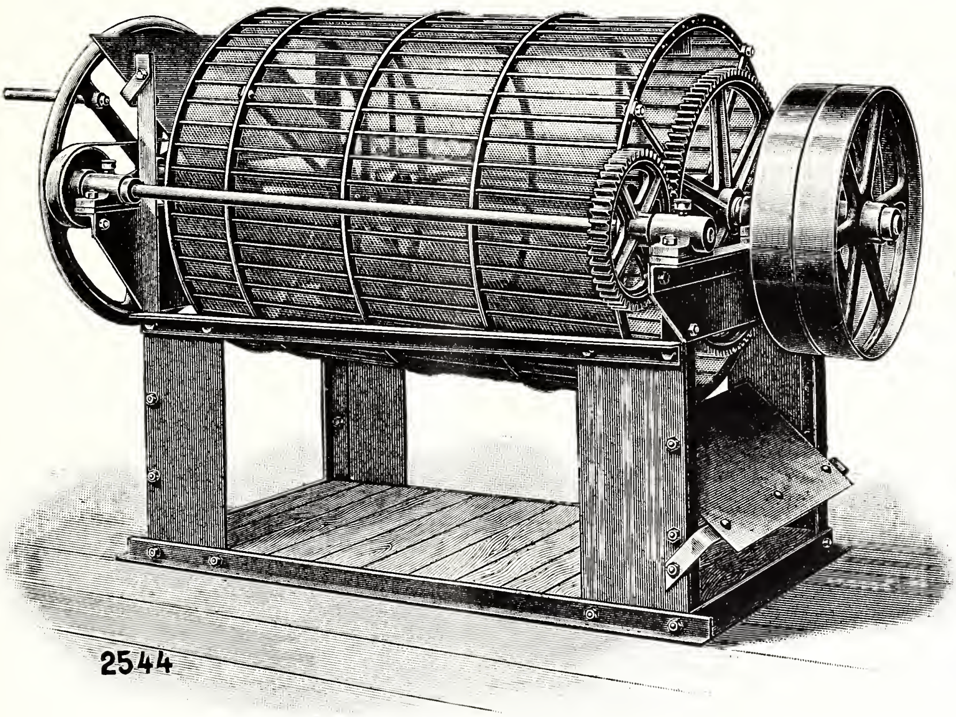
Fig. 16.



Sugar Conveyor.

the first factory must not start with a very large quantity of beetroots, because at the first it would be best to work only such a quantity as would make the factory remunerative. It should be only the preparation and nucleus for a larger factory, therefore the first beetroot factory should only work 25,000 tons of sugar beetroots per campaign. This quantity could easily be grown on 1,600 to 1,700 acres. The price of sugar I have put a little higher than the present price (for reasons which I have put before you a few minutes ago). In manufacturing sugar, you do not get all the sugar in the form of refined sugar, but there is another quality, made from the residue, which is called "yellow sugar," and which is sold at a very handsome profit to the confectioner, baker, brewer, &c., and which finds a very ready market in this country.

Fig. 17.



Sugar Sifter.

Molasses.

The molasses is a very excellent feeding material, and could be well disposed of at 3s. 6d. per cwt., or the factory could use the molasses itself in making feeding materials for the farmer. This is done on the Continent, where the sugar factories do an excellent business in the manufacture of feeding stuffs.

Slices.

The price of slices, or cossettes, as they call them abroad, I have put at the present market value of 10s. per ton, and inquiry has confirmed my view that they can be easily disposed of at this price.

Finance.

Our factory should have a capital of £60,000 to £80,000; £80,00 would be better, leaving a larger working capital at disposal. Should, however, there be any difficulty in obtaining this latter sum, there would be sufficient funds if a sum of £60,000 were available, but, of course, certain arrangements would have to be gone through with banks, or sugar consumers, in respect of advances which would supply the factory with the necessary working capital. But I think that such a contingency as that of begging for another £20,000 capital should not, and never will occur.

I base, therefore, my calculations on a capital of £80,000, which I distribute as follows :—

Machinery (costing)	£30,000
Building of factory	8,000
Leaving a working capital for paying for roots and working expenses of	42,000
	£80,000

Balance-sheet of a Beet-sugar Works

Capable of working 25,000 tons of beetroots in a campaign, or 300 tons of beet per day of 24 hours (working 83 days):—

Dr.	£ s. d.	Cr.	£ s. d.
Cost of beetroots, including expenses, 25,000 tons at 25s. per ton	31,250 0 0	3,000 tons refined sugar, produced at 13s. (in bond)	39,000 0 0
5 per cent. depreciation	1,500 0 0	2 per cent. (500 tons of yellow sugar at 11s. 6d. (in bond)	5,750 0 0
Profit	17,500 0 0	2 per cent. molasses (500 tons) at £3 10s. per ton	1,750 0 0
		30 per cent. slices 7,500 tons at 10s. per ton	3,750 0 0
	£50,250 0 0		£50,250 0 0

Here we have a gross profit of £17,500 on a capital of £80,000. If you take from this £17,500 a sum of £1,500 for any other expenses or any discrepancies which may occur, it leaves you £16,000, which would pay 20 per cent. profit on a capital of £80,000.

Now, I want to refer you to the different books I have published, and I must explain the discrepancies between this and my former calculations. In former years I only calculated on raw sugar, leaving out the whole profit of refining. This has all to be taken into consideration, especially as science has kept pace with the times, and we have made many improvements.

It will be opportune to mention the opinion of a gentleman regarding the establishment of a beet-sugar factory in this country; I mean Mr. George Martineau, C.B., who is one of the British delegates to the Brussels Commission. Mr. Martineau can speak authoritatively, having had many years' experience as a sugar refiner, and having studied the beet-sugar question thoroughly. Mr. Martineau, in regarding this question, speaks as follows:—

"The final consideration with regard to the sugar position created by the abolition of bounties is, perhaps, one of the most important. It was shown that beet-sugar could be grown in this country with as much success as on the Continent; but the Bounties stood in the way of further progress. That impediment having been removed, there is no reason why we should not produce from onr own land, and with our own labour, some of the sugar we consume. The country, I know, is absolutely apathetic on the subject, ignorant of the blessing that such an industry would bring to the British farmer, but, in some cases, even sufficiently prejudiced to declare that a scheme of this kind would be impracticable. There must be no experimenting on a small scale, the thing must be done with all the well established improvements, and on such a scale as to make success a certainty by reducing cost of production to a minimum. The very best land must be chosen, and plenty of it, well situated with regard to rail and water carriage, and with the certainty of obtaining a full supply of roots, cultivated in the most approved fashion, and contracted for in advance for several years. Under such circumstances, we shall have a new industry—agricultural and manufacturing, of the very first importance. One successful factory will show the way to hundreds more, and we shall again hold up our heads as agriculturists with a real home industry. To make the machinery for such an industry will require another new departure. The growing of the roots, we shall soon discover, will give us new ideas of farming and new energies on the land. Crops all round will improve, cattle will multiply, the railways and canals will discover new employment, and the labourer will go back to the land. This is a dream, but it can be made a reality."

There you have the mature view of a great authority.

I myself have worked very hard for this question (as I mentioned above), by voice, by writing to the papers, and by publishing numerous books and pamphlets, and yet since I started this campaign, we have sent abroad not less than £300,000,000 sterling, that might well have been retained in this country. I hope and wish that my appeal may not have been in vain, and if thereby I shall have done anything to introduce this gigantic industry into the country which has adopted me as a citizen, I consider myself repaid for the great sacrifice of time, labour, and the outlay of a great deal of money, all of which I have devoted to this cause.

You have heard what I have had to say, and it is now for you to help me in answering the question which I have put before you this evening. I hope your answer will be unanimous in saying: "It is advisable and profitable to cultivate sugar-beet, and to erect our own sugar factories, so that we can cover our own demand for sugar."

I must thank you for the great patience with which you have listened to my paper. The question we have discussed may be a very dry one, but it is a means to an end which is certainly sweet. Sugar is a commodity used by all, by the babe in its cradle, the aged, by man, woman, and child; everybody uses it, except the few unfortunate people, whom considerations of health have deprived of this force-giving food. Next to bread, sugar is the article of general diet, indespensable for us all.

It is surely an axiom that the ideal for a country is to produce herself all products which she consumes. If you help forward this end, you will have done a great service to your fellow creatures, to future generations, and you will deserve the gratitude of your country.

I must express my gratitude :—

To Messrs. Vilmorin, Andrieux and Co., of Paris, for lending me the blocks for the pictures of beetroots printed in this paper. (Figs. 1 to 4.) These beetroot designs are the registered property of this old and celebrated firm.

To Messrs. Watson, Laidlaw and Co., of Glasgow, for the blocks of the centrifugal machines, conveyors and sugar-sifter. (Figs. 14 to 17).

To Messrs. Braunschweigische Maschinenbauanstalt, for the blocks relating to the beet-working process. (Figs. 5 to 13.)

I give you below several tables relating to statistics about beet sugar, to show you the importance of this important industry :—

TABLE SHOWING THE HOME CONSUMPTION IN THE SIX PRINCIPAL BEET COUNTRIES, FROM THE 1ST SEPTEMBER, 1904, TO 1ST SEPTEMBER, 1905.

From the *Journal des Fabricants de Sucre.*

United Kingdom	1,533,733 tons.
France	542,314 ,,
Germany	962,856 ,,
Austria	445,016 ,,
Belgium	67,676 ,,
Holland	90,173 ,,

THE INCREASED SUGAR CONSUMPTION SINCE THE BRUSSELS CONVENTION CAME INTO FORCE (SEPTEMBER 1ST, 1903).

In consequence of the agreement of the Brussels Conference, arrived at on September 1st, 1903, the predicted increase in the consumption of sugar has been more than realised. The increased consumption has been greatest in the countries where the sugar-tax was renewed, and the incentive to exportation (bounty, premiums, &c.) taken away —Germany, Austria, France and Belgium— of which France shows the greatest increase, viz., from 23·7 pounds per head for the year 1902-3 to 44·11 pounds per head for the year 1903-4. The increase per head in the other countries in 1903-4 as compared with the preceding year, was as follows: Germany, from 26·51 to 37·44 pounds; Austria, from 17·4 to 23·17 pounds; Belgium, from 21·9 to 34·6 pounds.

In North America and Europe combined, the consumption of sugar per head of their populations, according to the German returns, was as follows :—From 32·6 pounds in 1902-3 to 37·8 pounds in 1903-4, an unprecedented increase of 5·2 pounds per head.

EUROPEAN SUGAR-BEET ACREAGE.

Though the prices of sugar in the markets of the world always did and always will fluctuate, as they are governed by the question of supply and demand, the acreage in Europe sown to sugar-beets has steadily grown. While it, too, had its ups and downs, the number of acres devoted to the beet-sugar industry has also been trebled within the last 25 years, as will be seen from the following table :—

Campaigns.	Acres.	Campaigns.	Acres.
1880-81	1,976,383	1893-94	3,484,763
1881-82	2,086,120	1894-95	3,775,061
1882-83	2,346,404	1895-96	3,311,671
1883-84	2,690,020	1896-97	3,789,901
1884-85	2,701,461	1897-98	3,734,508
1885-86	2,143,154	1898-99	3,869,847
1886-87	2,462,220	1899-1900	4,144,046
1887-88	2,184,096	1900-01	4,552,014
1888-89	2,469,892	1901-02	4,849,881
1889-90	2,795,371	1902-03	4,415,667
1890-91	3,098,924	1903-04	4,338,392
1891-92	3,186,804	1904-05	3,980,358
1892-93	3,213,479	1905-06	4,643,037

SUGAR-BEET CULTURE IN GERMANY.

It has been the expectation that low prices for beet-sugar in Europe would divert the cultivators of the soil in the great central plains of Europe from beet culture to others that would be more profitable, the low price of beet-sugar considered. That there will be some doubt about any material change in the relative proportions of beet culture and other cultures in Europe during coming years is indicated by some of the data recently given. During the five years—from 1898 to 1902, inclusive—the average annual value of the sugar-beet

crop was £12,000,000, of wheat £25,100,000, of oats £52,000,000, of rye £60,100,000, of barley £21,000,000, and of potatoes £64,000,000. This schedule includes only the leading farm crops of Germany, and in them we see that the sugar-beet, while occupying a conspicuous place, is one of the least in its total value. On the other hand, it is reported that the money value per acre of these various crops is as follows:—Sugar-beet £11, wheat £5 16s., oats £5, rye £4 4s., barley £5 4s., potatoes, £8.

We thus see that beet culture is one of the most intensive forms of German agriculture, and while capable of enormous expansion, it has not yet attained anything like its possible limit of expansion, and the beet cultivators and manufacturers will doubtless be in the field as active competitors with cane sugar during all the years to come. If the German cultivators should lose money in beet culture, their alternatives would be the grain crops, in which they would come into competition with the United States and Argentina.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM) TO END OF SEPTEMBER, 1904 AND 1905.

Imports.

	Quantities.		Values.	
	1904.	1905.	1904.	1905.
Raw Sugars.	Cwts.	Cwts.	£	£
Germany	4,752,046	3,769,613	2,146,973	2,204,850
Holland	227,412	91,610	111,978	63,722
Belgium	348,867	308,929	160,199	222,438
France	437,832	236,493	227,008	155,320
Austria-Hungary	683,432	370,920	307,428	243,766
Java	1,431,822	1,928,466	636,742	1,316,160
Philippine Islands	86,650	9,680	31,025	4 840
Cuba	..	..	..	..
Peru	839,506	995,924	391,730	657,278
Brazil	82,317	87,414	31,176	47,958
Argentine Republic	..	..	..	..
Mauritus	495,357	158,460	186,011	87,369
British East Indies	189,821	412,177	76,756	232,199
British West Indies, Guiana, &c.	824,521	901,137	533,439	725,664
Other countries	419,849	733,729	194,449	494,337
Total Raw Sugars	10,819,426	10,014,552	5,034,914	6,456,001
Refined Sugars.				
Germany	8,270,042	7,205,568	4,690,425	5,767,161
Holland	2,370,350	1,180,115	1,422,314	972,212
Belgium	367,751	189,478	212,967	155,639
France	2,105,017	1,491,796	1,185,416	1,102,102
Other countries	171,945	344,392	91,035	289,051
Total Refined Sugars	13,285,105	10,411,349	7,602,157	8,279,165
Molasses	1,336,620	1,874,108	245,177	373,808
Total Imports	25,441,151	22,300,009	12,882,248	15,108,974

Exports.

	Quantities.		Values.	
	1904.	1905.	1904.	1905.
British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	2,467	184	982	168
Norway	23,386	15,624	12,824	11,969
Denmark	86,282	63,832	44,037	45,643
Holland	47,834	58,388	25,752	45,044
Belgium	8,876	6,595	4,827	4,291
Portugal, Azores, &c.	12,944	11,419	6,975	8,329
Italy	3,238	4,965	1,515	3,253
Other countries	259,988	251,296	168,439	218,799
	445,015	412,303	265,351	337,496
Foreign and Colonial Sugars.				
Refined and Candy	19,992	19,323	13,805	16,640
Unrefined	91,260	73,435	50,434	51,818
Molasses	1,835	2,752	1,022	840
Total Exports	558,102	507,813	330,612	406,794

(From *The International Sugar Journal.*)

QUOTATIONS ON THE SPOT FOR A SERIES OF YEARS COMPARE AS FOLLOWS:—

	1905.	1904.	1903.	1902.	1901.	1900.	1899.	1898.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Java, D.S. 15, f.l. terms	9 0	13 9	10 0	8 9	9 0	12 6	11 9	12 6
West India, good brown	8 6	11 6	8 6	7 9	8 0	10 6	11 0	10 9
Pernams, 87° polarisation	8 0	11 3	8 3	7 6	7 6	10 0	10 3	10 6
Unclayed Manila, Taal	6 9	9 3	7 0	6 3	6 9	8 9	9 0	8 9
German beet, basis 88 per cent. prompt, f.o.b. Hamburg	8 0½	12 9	8 6¾	7 5½	7 3	9 5	9 1	9 8½
Refined "First marks" prompt, f.o.b. Hamburg	9 9	14 4½	10 1½	8 7½	8 3¾	11 1½	10 10½	11 6
Highest price of Sugar each year—								
Java, D.S. 15, f.l.	17 3	15 6	10 0	9 6	12 9	13 6	13 0	12 6
Pernams, 87° polarisation	14 3	12 9	8 4½	8 0	10 6	11 1½	11 9	10 6
German beet, basis 88 per cent. f.o.b. (prompt)	16 3½	14 6	8 6	8 5½	9 8¾	12 6½	11 5½	9 9½
First marks, granulated	17 10½	15 11¼	10 6	9 9¾	11 6	14 3	12 5¼	11 9
Lowest price of Sugar each year—								
Java, D.S. 15, f.l.	9 0	8 7½	9 0	7 9	8 9	11 6	11 6	10 9
Pernams, 87° polarisation	8 0	7 0	7 9	6 3	7 0	9 6	10 0	8 9
German beet, basis 88 per cent. f.o.b.	8 0	7 8	7 7	5 10½	6 6	9 1¼	8 11¼	8 11½
First marks, granulated	9 9	9 9	9 0	7 3¾	8 2¼	11 0	10 7½	10 9
Average price of Sugar each year—								
Java, D.S. 15, f.l.	10 11¼	9 7¾	8 4	11 1½	12 9¼	12 3	11 10	10 8¾
Pernams, 87° polarisation	9 2½	8 1¼	6 10¾	9 0¼	10 5	10 9¼	9 11½	8 8¼
German beet, basis 88 per cent. f.o.b.	10 0	8 2½	6 7½	8 7¾	10 5	10 0¼	9 5¾	8 10¼
First marks, granulated	11 9¾	9 9	8 1¾	10 5¼	12 1½	11 7¼	11 2½	10 9½

(From J. W. De Silva's circular.)

BEET-SUGAR CROP
(in Tons)
According to Licht, Magdeburg.

	1905-6.	1904-5.	1903-4.	1902-3.	1901-2.
Germany	2,225,000	1,563,161	1,927,681	1,762,461	2,304,923
Austria	1,380,000	871,168	1,167,959	1,057,692	1,301,549
France	1,000,000	608,590	804,309	833,210	1,123,533
Russia	1,020,000	936,858	1,204,134	1,261,311	1,098,983
Belgium	320,000	175,534	203,446	224,020	324,763
Holland	200,000	136,551	123,551	102,411	203,172
Sweden	118,000	82,000	107,199	72,444	125,948
Denmark	64,000	44,250	47,000	37,067	55,132
Italy	90,000	78,381	130,861	95,191	74,299
Roumania	30,000	19,863	25,137	16,381	20,576
Spain	95,000	98,700	113,842	96,160	73,329
Other countries	8,000	8,000	6,949	13,929	15,329
Total	6,550,000	4,623,056	5,862,068	5,572,267	6,722,051

CANE-SUGAR CROP
(in Tons)
According to J. W. De Silva's Circular.

	1905–6.	1904–5.	1903–4.	1902–3.	1901–2.	1900–1.
Cuba	1,250,000	1,100,000	1,000,000	958,000	800,000	580,000
Porto Rico	160,000	145,000	125,000	85,000	85,000	75,000
Trinidad	40,000	28,000	46,000	45,000	45,000	54,000
Barbadoes	50,000	40,000	58,000	35,000	44,000	55,000
Jamaica	20,000	16,000	15,000	18,000	20,000	25,000
Antigua and St. Kitts..	19,000	19,000	18,000	15,000	15,000	20,000
Martinique	25,000	25,000	24,000	30,000	35,000	39,000
Guadeloupe	35,000	36,000	40,000	38,000	30,000	35,000
Demerara	120,000	130,000	108,000	133,000	121,000	93,000
Réunion	30,000	28,000	25,000	30,000	30,000	33,000
Mauritius	180,000	130,000	210,000	150,000	160,000	172,000
Java..	975,000	998,000	910,000	830,000	690,000	660,000
British India	15,000	15,000	10,000	14,000	10,000	8,000
Brazil	200,000	151,000	156,000	160,000	300,000	250,000
Manila, Cebu, and Ilo-Ilo	120,000	120,000	84,000	89,000	92,000	55,000
United States..	310,000	330,000	215,000	280,000	310,000	270,000
Peru	100,000	90,000	75,000	53,000	47,000	54,000
Egypt	50,000	50,000	50,000	50,000	48,000	53,000
Sandwich Islands	360,000	350,000	328,000	390,000	317,000	320,000
Argentine	130,000	126,000	142,000	130,000	135,000	114,000
Australia..	200,000	180,000	150,000	100,000	130,000	120,000
	4,389,000	4,107,000	3,789,000	3,633,000	3,464,000	3,085,000

AVERAGES AND RESULTS OF THE EXPERIMENTAL WORK IN SUGAR-BEET CULTIVATION CARRIED OUT BY SIGMUND STEIN, LIVERPOOL.

(a). Average Yield of Sugar-Beet per Acre.

Year.	Tons per Acre.		Year.	Tons per Acre.
1897	16·07	......	1901	19·04
1898	16·03	......	1902	15·90
1899	16·09	......	1903	14·50
1900	19·01	......	1904	16·86

(b.) ANALYSIS OF SUGAR-BEET ROOTS.

Year.	Country.	Average weight of root with leaves in grammes.	Average weight of root without leaves in grammes.	Degrees Brix (dry matter).	Specific gravity.	Quantity of sugar in 100 parts of the juice.	Quantity of non-sugar in 100 parts of the juice.	Quotient of purity.
1897	British	1,229	804	18·44	1·076	15·80	2·64	85·64
	German	1,148	561	17·81	1·074	15·07	2·74	84·05
1898	British	1,371	843	19·05	1·079	16·54	2·51	86·82
	German	974	539	19·02	1·079	16·32	2·70	85·80
1899	British	1,644	902	19·00	1·079	16·30	2·70	85·78
	German	957	611	18·30	1·076	15·45	2·85	84·42
1900	British	1,525	790	19·52	1·081	17·07	2·45	87·45
	German	1,064	557	20·00	1·083	17·38	2·62	86·90
1901	British	1,441	851	19·38	1·180	17·02	2·36	87·82
	German	1,112	621	17·66	1·073	14·76	2·90	83·53
1902	British	1,326	878	19·29	1·080	16·80	2·49	85·11
	German	1,042	492	17·43	1·072	14·79	2·64	82·74
1903	British	1,516	933	19·93	1·083	17·28	2·65	86·98
	German	1,100	560	19·70	1·082	16·87	2·83	85·63
1904	British	1,491	892	20·25	1·084	17·65	2·60	87·04
	German	988	616	20·90	1·087	18·32	2·58	87·66

The 11th Report of Stein's beet-growing experiments (1905) will be published January, 1906.

DISCUSSION.

The CHAIRMAN said he did not pretend to be either an agriculturist or an expert sugar grower, but he was present merely in the capacity of a humble landowner who had taken some interest in the question through reading about it seven or eight years ago. He at once realised that although considerable experiments had been carried on with regard to sugar beet growing in other parts of England, Scotland, and Ireland, nothing had been done in Warwickshire, where he resided. He thought he should like to make an attempt, so he began by growing beet on small plots on his own account, and the experiments were satisfactory, but he thought that probably a certain amount of suspicion might be attached to a landlord's experiment, so he invited some of his tenants to co-operate with him. Accordingly, four of his tenants each grew about an acre of beet in the middle of a crop of mangold-wurzel, in order that they might be sure it was a real result of what might be called general agriculture. The roots were weighed at the end of the season each year, and samples of each root grown were sent up to Mr. Stein for analysis, the results being carefully tabulated and published. The experiments were continued for several years. Not the least interesting portion of the experiment was that two of the years, 1902 and 1903, were very short of sun; and although some of the most experienced agriculturists had told him over and over again that it was perfectly useless to attempt to grow sugar-beet in England because there was not sufficient sun to develop the necessary saccharine qualities, yet in those particular years there was hardly any difference whatever in the saccharine contents. He thought the experimental stage had now been carried far enough. Obviously the first thing to do before attempting anything on a large scale was to see whether beet could be grown in this country of a sufficiently good quality to enable people to treat it on a commercial scale, and he thought that had been satisfactorily proved experimentally. At the present moment, however, they were at a full stop. The farmers said it was no use growing beetroot because there was no factory to send it to; and, on the other hand, capitalists as yet had not put up anything in the nature of a factory, because they said there was no beetroot grown in the country. There was another thing which was also rather disheartening to capitalists at the present moment. The first objection, the sugar bounties, had vanished. While sugar bounties existed and were liable to variation, British capitalists could not be certain that, if they embarked a large amount of capital in the manufacture of beet-sugar, the bounties would not be altered to their disadvantage, and they would thereby be left with an unprofitable industry. The wet blanket which was hanging over them now was the question of the excise. When the Sugar Duty Act was passed a few years ago, power was only taken to impose an import duty, because no sugar was made in this country. He had ascertained on the highest authority that there was at the present moment no power, without going to Parliament for special powers, to impose an excise duty, but, in accordance with the fiscal system which all worshipped so reverently, supposing anything in the nature of a

sugar industry was started it would be the bounden duty of the Chancellor of the Exchequer at once to ask Parliament for the protection of the revenue and the mainteuance of the fiscal system, and to clap on an excise duty equal to the import duty, viz., 4s. 2d. a cwt., which would effectually strangle the new industry almost before it was born. Even if the Chancellor of the Exchequer were to do as Lord Nelson did at the Battle of Copenhagen—put his telescope to a blind eye—when asked to look at the sugar industry that was growing up, he could not be expected to do so for very long, and even although the sugar industry might not perhaps be taxed for a short time it would always be labouring under the fear of being eventually taxed. While that condition of things existed it was obviously impossible to place the matter, in a commercial sense, before anybody who would be likely to put down the requisite capital. It was a very great pity that something could not be done for the furtherance of the industry. Sugar was successfully grown in every portion of the Continent of Europe, in Sweden, and in the United States, and yet England alone did nothing. He believed it was a fact that wherever it had been grown it had improved the agriculture of the district, because sugar-beet could not be grown successfully without doing the land well, and if that was done for one crop it obviously benefited the succeeding crops. In referring to the labour question, Mr. Stein had said that one reason why beet was not grown in this country was because they did not want to deal with the unemployed question. He fully agreed with Mr. Stein that if an industry could be started on a large scale (of course, it would be many years before it grew to be a large industry), it would undoubtedly give a great amount of employment on the land where very little labour was used at present, but the question of labour was largely a question of wages. If the farmers could afford to pay really satisfactory wages to the men whom they employed on the land there would be no difficulty, he thought, in getting labour; and the question of wages was entirely governed by the price which the manufacturers could afford to pay the farmers for their beetroot, while the amount which a farmer could afford to take for his beetroot was governed also, to a great extent, by the size of the crop which he could grow. He had hitherto looked upon twelve tons to the acre as being a safe average to take, because it was better in such matters to under-estimate rather than to over-estimate. Mr. Stein, on the other hand, thought fifteen or sixteen tons was a safe average. If that was right, so much the better. Hitherto he had reckoned upon being able to get £1 a ton for clean beetroot for the farmers; Mr. Stein thought 18s. would pay them well, and certainly if they could grow crops according to the author's balance sheet, and make £7 10s. an acre on their beet crop, there would be nothing to complain about—in fact, he would go so far as to say that if they could make half that amount, £3 15s. per acre net profit, there were many farmers in the country who would be only too pleased to jump at it. There was no doubt it was a great industry, and now that prices seemed to be settling down and becoming more normal than they were after the Sugar Convention abolished the bounties, when prices fluctuated so widely, the time had arrived when people might seriously consider the matter, and anybody who would come forward and find the necessary capital for the starting of the industry would be a benefactor to the whole of the agriculturists of the country. The only thing required was for the experiment to be successful. Some years ago an attempt was made to grow sugar at Lavenham, but, unfortunately, it proved to be a financial failure, and whenever you talked of sugar now-a-days to some people, they immediately threw Lavenham in your face, and said the attempt which had been made had failed. But many things had happened since then. The beetroot had vastly improved; the percentage of sugar obtained from beetroot was very largely increased, and consequently a larger profit could be made from the same crop. The machinery and plant for treating the sugar had also improved, and there were much better methods of traction, a most important consideration. With motors, the growers were not tied to their own locality, so that if their farms were not favourably situated in regard to water carriage, there was no reason why, with a properly organised system of motor carriage, they should not be able to transport their beetroots at a very reasonable rate to a much larger radius round about than was formerly the case. The more one learned from those who were thoroughly acquainted with the subject, the more one felt that there was no reason whatever why, because the experiment failed at Lavenham a good many years ago, it should fail if started now. The one thing which blocked the way was the fiscal goddess which was reared up and which had to be worshipped; and until some sort of guarantee was obtained that a heavy excise duty would not be put on sugar, but that some encouragement would be given by the powers that be, it seemed to him almost hopeless to attempt to get people to go in for sugar beetroot growing on a large commercial scale.

Dr. Gustaf Schack-Sommer stated that in the year 1889, having read of the experiments of Mr. Newlands and Professor Sutherland, he was encouraged to try the experiment of growing sugar beetroot in England, Scotland, and Ireland, and subsequently Mr. Stein came over to England and assisted him in further experiments up to the year 1895. When he started his experiments in 1889, the average price of beetroot sugar was 15s. 5d., and it gradually dwindled, until in 1895 it was only 9s. 7d. He thought it was then time to stop experimenting, because the farmers who had planted beetroot on his advice, wrote and asked him what they were to do with their crops, and he was obliged to advise them

to feed their cattle on them. Mr. Stein had asked how it was that English people did not grow their own beet and make their own sugar. It seemed to him the answer was very simple. It took 8 tons of roots, or possibly $7\frac{3}{4}$ tons, to make a ton of sugar, which was a 12 per cent. yield; and if £1 a ton was paid to the farmer for his crop, it meant that the manufacturer had to pay £8 for the roots for a ton of sugar, without taking into consideration the manufacturing expenses and carriage. In his opinion, the author's statement that 15 tons of roots could be grown per acre was exaggerated, the average figure being nearer 12 or 13 tons. Mr. Stein had mentioned that he had known 40 tons to be grown on an acre. If that was the case, he (Dr. Sommer) knew several Museums which would be glad to have specimens of the crop. But, even taking Mr. Stein's statement that 15 tons of beet could be grown to the acre, for which the farmer received £1 a ton, he believed it was the fact that an average crop of mangold-wurzel was 30 tons to the acre, yielding 14s. to 15s. a ton, which worked out at £18 15s. per acre against £15 per acre for beet. If a farmer could get more profit by growing mangold-wurzel, why should he grow sugar-beet? Mr. George Martineau, who aasisted the British representatives at the Brussels Sugar Convention, had published in his well-known book, the statement that the cost of beet-sugar was 10s. per cwt. if 16s. 8d. per ton was paid for the roots. Therefore, in answer to Mr. Stein's question, in his opinion the farmer did not take up the industry because the profit he could make out of growing sugar beetroot at present prices was not remunerative enough. He did not see any reason why sugar should advance in price in the next few years, and he did not think therefore the capitalist had any justification in risking his money in an enterprise which on paper to-day showed a net loss of practically 2s. per cwt.

Mr. B. E. R. Newlands remarked that the Chairman had stated that the Lavenham works were run at a loss, and therefore had to stop. That was not the case at all. Lavenham never lost money until the war occurred between Germany and France, when the bounties were very greatly increased owing to the increase of duty, making it impossible to compete; but up to that time Lavenham was carried on successfully from a financial point of view. Mr. Duncan tried to induce agriculturalists in every county in the United Kingdom, and particularly capitalists, to start growing sugar beetroot, because Mr. Duncan did not go into the manufacture of sugar with the idea of making money, but simply for the purpose of inducing other people to go into the business. After very mature study, extending over many years, he (Mr. Newlands) had arrived at the conclusion that beetroot sugar would not be profitably produced in England unless the growers were given the benefit of the 2s. 6d. per cwt. surtax which the growers on the Continent had, and there was not the slightest chance of getting that benefit. On the other hand there was more probability of the duty on sugar being taken off, and obviously, if that was done, the growers would not be able to get the surtax of 2s. 6d. Again, if the home growers were allowed a surtax of 2s. 6d., what would the West Indies and the other Colonies say? They would also want the 2s. 6d. off, which it would be impossible to give, because, under the Convention, England had no right to treat her Colonies differently to the way she treated foreign countries. He would give a good many years of his life if he could see the sugar beetroot industry at work in England, but the chances were absolutely nil unless a very radical alteration occurred in the political aspects of the time. The Government in process of formation would probably reduce the sugar duties to nothing, and the chance of establishing a sugar industry in England would then absolutely vanish. If, on the other hand, English growers were placed in the same position as those of the other Powers who signed the Convention, and were paid 2s. 6d. a cwt. surtax, he would put money into the scheme and recommend his friends to do the same. But under the present circumstances it was no use; and even with the genius of Mr. Stein it could not be done.

Mr. Donald Reid stated that sugar-beet could be grown in India which produced 16 per cent. of sugar. If beetroot could not be grown commercially in this country for sugar-making he thought it would be possible to at least supply seed from England to grow sugar-beet in India on a large scale. With a certain amount of encouragement, an enormous amount of beetroot could be grown in India, particularly in the North-Western Provinces. At present India was a large importer of sugar; but if it grew its own beet, and also sugar cane, he had no doubt it would be able to supply at once all the 300,000,000 natives of the country.

Mr. A. H. H. Matthews (Secretary of the Central Chamber of Agriculture) said it seemed rather ungracious to offer any word of criticism after all the work Mr. Stein had done, but the criticism he wished to offer was with a view to helping forward the question and retaining an interest in it. He could not accept the figures Mr. Stein had given in the paper, and did not think the author would help his cause by giving too rosy a colour to the scheme, because if that were done the practical farmer would simply laugh at it. In his opinion the £7 15s. as the profit of an acre of beet was not correct, and the figures on the other side of the account were excessive. The Chairman, in experiments, showed an average of nearer twelve tons per acre than fifteen, and he believed it was the same in some of the continental countries. He thought Mr. Stein would benefit his own cause if he allowed a higher rate of expenditure and a lower rate of income, that would still leave a balance on the right side, and the movement would then meet with more encouragement. He wished to ask in

conclusion whether any experiments had been made in England of growing beet for consecutive years on the land, and if so with what result?

Mr. W. H. Knight said the paper was an eye-opener to those who knew a little about agriculture. In the first place, farmers were told they could make a very good profit from beetroot growing, and then Dr. Schach-Sommer had said they could make an infinitively greater profit by growing mangold-wurzel. The rosy state of the affairs pictured by Dr. Schach-Sommer from the growth of mangold-wurzel was new to many men in London as well as to many men in the country, otherwise the statistics which were published in the daily papers were very misleading. According to Dr. Schach-Sommer, there was no need whatever for any agricultural depression. If farmers could make such colossal profits out of the cultivation of mangold-wurzel, there was no necessity to think about growing beet at all. His own opinion was, however, that sugar-beet could be grown in this country at probably a good profit. It was a very striking thing to him that Mr. Newlands, who had been so closely identified with Mr. Duncan in the experiments that were made in the production of sugar at Lavenham, should so differ from Mr. Duncan in his view of the possibility of making a profit from sugar-beet. Two years ago he obtained from Mr. Duncan personally, a statement in writing that, provided beet could be produced in this country on a similar basis to that on which it was produced on the Continent, a profit would be made, but that it was impossible to make sugar in this country at a profit under the present system. If the manufacturer relied on the farmer supplying them with beetroot at a given price, the chances were they would be in the farmers' hands, and they would raise the price. But Mr. Duncan said if a sufficiently large syndicate could be formed, with sufficient capital to buy land, or to work on the co-operative principle, then, in his opinion, the industry could be made profitable.

Mr. Newlands said that he discussed the matter with Mr. Duncan only a week before he died, and they were both entirely agreed that, provided the English growers worked on the same conditions as those on the Continent—namely, 2s. 6d. a cwt. surtax, sugar beetroot could be grown to a profit in England.

The Chairman inquired whether it was Mr. Newlands's opinion that, unless home growers obtained 2s. 6d. per cwt. surtax, what would militate against beet growing in England was purely a question of labour?

Mr. Newlands replied that it cost £9 per ton to produce an 88 per cent. beetroot sugar on the Continent, and exactly the same in this country. The English manufacturer could produce it just as cheap because he had cheaper fuel and the labour and rent were not dearer. Sugar could not be produced on the Continent at present prices to pay unless the manufacturers had the 2s. 6d. surtax to tax their own countrymen with, using a portion of the money obtained in that way to enable them to supply cheap sugar for abroad.

Mr. Stein, in reply to Dr. Schach-Sommer's statement that the beetroot gave only a 12 per cent. yield of sugar, said that the official statistician to the German Empire in his report for the present year, issued only in the previous week, stated that the yield in Germany was 14·7 per cent. Further, the roots in Germany for the next season had been contracted for at 14s.; and he had offered to grow 30,000 tons of sugar-beet in Lincoln at 18s. a ton. He had mentioned that the present price of sugar was less than the cost of production, the over-production of two million tons during the present year keeping the price down. The French sugar smash had also occurred, and the contracts of the French financiers were still hanging over the market. The statement had been made that Mr. Martineau was very pessimistic about the prospects of growing sugar-beet in this country, but, as a matter of fact, he had quoted in the paper a long extract from Mr. Martineau showing that he held exactly the opposite opinion. Mr. Martineau had stated within the last few weeks that, now that the bounties were abolished, sugar factories should be started in England. It had been suggested that the yield of roots per acre was only 12 tons, but the average was quite 15, and even 18 and 20. He had received such figures from farmers who grew large crops of beet, and on the five or six-acre plot of the Liverpool Corporation the roots had been actually weighed, and came to about 25 tons per acre. One speaker had asked if beetroots could be grown for several years in succession. A gentleman at Leamington, in Hampshire, had told him that he grew sugar beetroots for twenty-five years on the same plot. Dr. Schach-Sommer had said that the salvation of the British farmer was to grow mangold-wurzel, which yielded 30 tons to the acre. As a matter of fact, the Board of Agriculture returns for the last 10 or 15 years showed that the average yield in Great Britain and Ireland was only 18 tons; while instead of it fetching 14s. or 15s. a ton, in the opinion of Mr. Cave, the estate agent of the Chairman, it only realised 11s. In addition to that, sugar beetroot was contracted for 5 or 10 years in advance, and the same ready market could not be obtained for mangold-wurzel. He quite agreed with the statement that it cost 9s. to produce sugar from beetroot. The present price of sugar was 8s. 6d., and if it went up another 1s., which was quite possible, it would pay to make sugar in this country. If people went about the country throwing cold water on the scheme and saying it was no good there would never be a sugar industry in England.

The CHAIRMAN, in proposing a cordial vote of thanks to Mr. Stein for his exceedingly interesting and instructive paper, said it was always a disappointment to have cold water poured on a scheme. It was really a question of price. Although the margin between profit and loss was so small that it might be non-existent with the present price, it was possible that if the consumption of sugar went on increasing on the Continent in the way it had done since the abolition of the sugar bounties, they might see sugar at a better level than it was at the present moment. The more the subject was ventilated, and the more they made the fiscal authorities realise how important the development of the sugar industry was to the country, the more hope there was of making a step in the right direction.

The resolution of thanks having been carried unanimously, Mr. STEIN briefly acknowledged the compliment, and the meeting terminated.

HOME INDUSTRIES.

The Motor-Omnibus Industry.—If it would be an exaggeration to say that every week sees the publication of the prospectus of some new company formed for the purpose of running motor omnibuses in and about the metropolis, it is at least true that these companies are becoming numerous, and that there is every reason to believe that the capital in this new industry will soon be very great. The prediction of experts, made only a few months ago, that the motor-'bus could not successfully compete against the electric tramway is but another illustration of the unwisdom of relying upon expert opinion when it is a question of the development of a new industry. It was admitted that the motor omnibus mght be useful as a feeder of tramways and of railways, but "for the purposes of rapid transit and the effective handling of large volumes of traffic, the road carriage must prove inferior to the rail-borne vehicle." Experience is not supporting this theory. Even now it is found that the motor omnibus has great advantage over the electric tramway in the more crowded parts of the city, its speed is equal to that of the tramway, the capital required to work a motor-'bus service is very much less, and no permission is required from local authorities as with the tramway. As time goes on there is certain to be immense improvement in the motor omnibuses. They will be cheaper, less noisy, the smell, which is sometimes unpleasant, will be got rid of, and it is quite possible that in many districts they will very seriously interfere with the profits of tramways and railways. The position is not without its difficulties for municipal authorities committed to large schemes of tramway enterprise.

Uganda Cotton.—It is pleasant, amongst many disappointments, to be able to refer to the very promising results obtained from the experiments made in the cultivation of cotton by the Uganda Trading Company. As has been noticed in the *Journal*, the experiments in cotton growth made in several of the Colonies have not as yet been very promising in their results, but in Uganda the outlook, if the experience of the Uganda Trading Company may be accepted, is much brighter. Early last year, this company gave out seeds to some twenty-eight cultivators, and up to the date of Colonel Hayes Sadler's report, from which these figures are taken, the cultivators have brought in about 45 tons of unginned cotton. Fifty-two bales had been shipped to Liverpool, and another fifty bales were ready for shipment. Now nearly 500 cultivators have applied to the company for seed, and from the quantity given out they expect to receive some 300 tons of unginned cotton within the next few months. The variety of seed which is found to answer best is the American Upland. Egyptian Affifi is reported to have produced a fair quantity, but of inferior quality, the staple being greatly discoloured, and short, and weak. Egyptian Abbasi promises well; the staple is clean and long, and of fair length, and fine. The quality of the local indigenous cotton is also well reported on. Asmouni and Black Peruvian have not been a success, but as the latter is a semi-perennial it may produce a crop later on. Altogether there seem to be good grounds for the belief that an extensive cotton industry may spring up in Uganda.

Employers' and Workmen's Compensation.—It is strange how difficult it is to predict, with any approach to accuracy, the full effects of Acts of Parliament intended to serve the interests of trade, as to protect the rights of individuals. When Mr. Gladstone passed his first Irish Land Act, 1870, he and his supportors believed that it would give the Irish tenant security against eviction. In fact, it added largely to the number of evictions. When the Trade Marks Act was passed, it was believed by its framers and supporters that it would deal a heavy blow to German competition. In fact, it proved of enormous value to German trade, not only with England but with the world. And so with the Workmen's Compensation Act. One of the worst drafted Acts ever passed by Parliament, it has been of great service to a comparatively limited section of workmen. Amended in directions indicated by judges and others, it may be of much greater service to a much larger number of workmen. But here, as in so many other cases, the man who is in special need of protection, or assistance, not only derives no benefit from the Act but suffers from it. As Sir Benjamin Browne points out "Small manufacturers and farmers are becoming increasingly unwilling to employ men more than they can possibly help, and it is becoming more and more difficult for middle-aged, infirm, and one-eyed men to get work at all." In other words, an Act

intended to benefit workmen generally only helps a section of them, and is of distinct and serious disadvantage to others. It has added to the army of the unemployed, for employers will not employ men whose physical powers are not perfect, or give an odd day or two of charitable employment to some casual poor man lest some slight accident leads to troublesome claims.

International Exhibitions and Trade.—Competent opinion differs very much as to the value to home industries of International Exhibitions, but there will be general agreement that when this country is represented at them it should make a good show. There are fears that this may not be the case at Milan next year. For some time the attitude of the Government towards the Exhibition was doubtful, and although it has since made a grant it is a very small one. The British section will be represented by a strong Commission, including Lord Brassey and Sir Albert Rollit, M.P., but they will be much crippled by lack of funds. For the St. Louis Exhibition of last year the Government made a grant of £148,000, for the Milan Exhibition of next year they give only £10,000. Again, whilst the War Office, Admiralty, Government of India, Post Office, and other departments were well represented at St. Louis, it seems doubtful whether they will be represented at all at Milan. On the other hand, our commercial rivals intend to be very fully represented. France has 258,000 square feet more than at St. Louis, Germany has appointed a special commission, and her Government departments will be very fully represented; and so with every other Continental nation of any importance, and the United States. They all promise to make a brave show, whilst even in the building devoted to maritime transport it is by no means certain that the British section will take that prominent place it ought to take as representing the leading maritime power of the world.

Consular Reports and Home Industries.—During the last week or two an unusual number of Consular and Colonial Reports have been issued, and they contain much valuable information for those interested in home industries. Of late years there has been marked improvement in the way in which the reports are issued. At one time the Consuls and Colonial officers who sent them delayed reporting so long that when the reports reached the hands of manufacturers and others they were of little or no value. They were belated. But of late there has been great improvement in this respect, and when the difficulties associated with the collection of the statistics are remembered it will be admitted that, except in very rare cases, there is very little avoidable delay in the completion of these reports. But it is a fact deserving the consideration of the Departments concerned whether it would not be practicable to issue Consular and Colonial information oftener. It is true that occasionally Consuls send home some items of information which the Board of Trade makes public without waiting for the annual report, but this might be done oftener to advantage, as many think. Of course there are some Consular districts where the business done is so small, trade with this country so insignificant, and so incapable of expansion, that it would be only waste of time and money to add to the annual report, which in itself, is as barren as it well can be. But there are other Consular districts in a very different position. The Consuls stationed in Belgium and Germany, for example, send home most valuable reports upon the movements of trade in those centres. They are formidable competitors of the United Kingdom, and it might be of great service to home trades if men like Sir William Ward, to name only one of several very able members of the Consular staff stationed in Northern Europe, reported more frequently upon trade matters coming under their notice. Such reports might be of the briefest kind and yet be of great value.

Colonial Trade Reports.—It seems a great anomaly that whilst the United Kingdom has Consuls in every European country, and in all foreign places where this country does, or hopes to do, any trade of importance, it is without official representatives in the greater Colonies charged with reporting upon trade affairs. The Consul tells us, more or less fully, what is happening in the foreign country or district represented by him. The Governor or Colonial Secretary sends home his annual report upon affairs in the Crown Colony for which he is responsible. But the Governors of the Dominion of Canada, of the Commonwealth, of the Cape and Natal, do not report in this way to the Home Government. There are, of course, the official compilations issued by the Colonial Governments, and most exhaustive and excellent many of them are. But these deal with the general trade of the colony issuing them, and not specially with British trade interests. Yet the Colonial markets, as represented by Canada, Australia, the Cape, New Zealand, are very great markets, in which, if at present we hold a commanding position we do not hold it without great difficulty. Now, in more than one of these markets, as, for example, Canada, we are losing ground, and we are doing so in the opinion of local and home authorities in the best position to know because our manufacturers are slow to adapt themselves to changing conditions, and not always well posted in the special wants of the markets concerned. If it is necessary for the purposes of our trade that Consuls should report from Antwerp, Rotterdam, Berlin, Marseilles, Genoa; that Governors should indicate the trend of trade in the Straits Settlements, Barbados, Jamaica; surely it is equally necessary that the home trader should have official assistance, in equal degree, in ascertaining what is going on in the great markets of the Dominion, the Cape, and Australasia.

OBITUARY.

HARRY WITHERS CHUBB.—Mr. Harry Chubb died on Friday, December 1st, after a sad accident which occurred at the Colonial Office, where he fell down an unlighted flight of stone stairs. Mr. Chubb was Managing Director of Chubb and Son's Lock and Safe Company, Ltd., and he introduced many new methods and machines for making locks, safes, and bankers' treasuries. On April 12th, 1893, he read a paper before the Society of Arts on "The Construction of Locks and Safes." Mr. Chubb was an Associate of the Institution of Civil Engineers, and he was elected a member of the Society in 1886.

SIR CLINTON DAWKINS, K.C.B.—Sir Clinton Edward Dawkins died on Saturday, 2nd inst., at his house in London. He was one of the sons of Clinton George Dawkins, at one time Consul-General at Venice, and was born in 1859. He was educated at Cheltenham College, whence he passed to Balliol in 1878. On leaving Oxford, he entered the India Office, and in 1886 he became private secretary to Lord Cross, then Secretary of State. He was subsequently transferred to the Treasury, and was private secretary to Mr. (now Lord) Goschen in 1888. From 1891 to 1894 he was representative of Peruvian bondholders in South America. From 1895 to 1898, he was Under-Secretary for Finance in Egypt, and from 1899 to 1900 Financial Member of the Viceroy's Council in India. In April, 1900, he returned to London to take up his position as partner in the firm of J. S. Morgan and Co. In 1901, he was chairman of the committee appointed to investigate the organisation of the War-office. Sir Clinton Dawkins was elected a Member of the Society of Arts in 1900.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

DECEMBER 13.—"The Commerce and Industry of Japan." By W. F. MITCHELL. HIS EXCELLENCY THE JAPANESE MINISTER, will preside.

DECEMBER 20.—"The Aerograph Method of Distributing Colour." By CHARLES L. BURDICK.

COLONIAL SECTION.

Thursday afternoon, at 4.30 o'clock:—

DECEMBER 14.—"Glimpses of French Canada." By the HON. RODOLPHE LEMIEUX, K.C., M.P., Solicitor-General of Canada. The RIGHT HON. LORD STRATHCONA, G.C.M.G., will preside.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

DECEMBER 12.—"Historical Pageants." By LOUIS N. PARKER. SIR MARCUS SAMUEL, BART., Vice-President of the Society, will preside.

Papers for meetings after Christmas:—

"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.).

"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.

"Submarine Signalling." By J. B. MILLET.

"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"The Planting of Waste Lands for Profit." By DR. J. NISBET.

"Industrial Russia." By LUCIEN WOLF.

"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON.

"The Artistic in Painting and Photography." By J. C. DOLLMAN, R.I.

"Illuminated MSS." By H. YATES THOMPSON.

"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A.

"Cut Glass." By HARRY J. POWELL.

"Basket Making." By THOMAS OKEY.

"The City of Calcutta." By CHARLES EDWARD BUCKLAND, C.I.E.

"The Languages of India and the Linguistic Survey." By DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit.

"Seistan: Past and Present." By COLONEL ARTHUR HENRY MCMAHON, C.S.I.

"The Navigable Waterways of India." By ROBERT BURTON BUCKLEY, C.S.I.

"The Parsis of Persia." By MAJOR PERCY MOLESWORTH SYKES, C.M.G.

"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E.

"Imperial Questions in the West Indies." By SIR NEVILE LUBBOCK, K.C.M.G.

"Motor Boats." By BERNARD B. REDWOOD, B.A.

"The Scientific Aspects of Voice Development." By WILLIAM A. AIKIN, M.D.

"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT.

"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE.

"The Fisheries of the North Sea." By WALTER GARSTANG, M.A.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

J. A. FLEMING, D.Sc., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (In continuation of previous courses on "Electric Oscillations and Electric Waves," and on "Hertzian Wave Telegraphy.") Four Lectures.

LECTURE III.—DECEMBER 11.—*Measurement of Frequency and Resonance.*—Time period and oscillation constant of a condenser circuit—Closed and open circuit syntonic circuits—Theory of resonance—Experiments illustrating resonance—Resonance curves—Determination of the total decrement from resonance

curves—The Cymometer—Its use for determining small capacities and inductances—Theory of the oscillation transformer—Analysis of the phenomena of the oscillation transformer by the aid of the Cymometer.

LECTURE IV.—DECEMBER 18.—*Measurement of Free and Stationary Wave-Length.*—Stationary waves on wires—Velocity of propagation—Mechanical model—Loops and nodes of potential and current — Special qualities of spirals — Methods of detecting loops and nodes—Radiation from aërial wires—Velocity of free waves—Relations of free-wave lengths to antenna length—Direct and inductively coupled aërials—Determination of the wave-length and damping of the waves radiated from antennæ—Methods of syntonising coupled circuits with the Cymometer.

HOWARD LECTURES.

A Course of Three Lectures will be given under the Howard Trust, by PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., on "High Speed Electric Generators, with special reference to driving by Steam-turbines," on the followng Thursday Evenings, at 8 o'clock:—January 18th and 25th, and February 1st.

JUVENILE LECTURES.

Two lectures suitable for a Juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, 1906, at 7 o'clock, by PROFESSOR HERBERT JACKSON, on "Flame and Combustion."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. J. A. Fleming, "The Measurement of High Frequency Currents and Electric Waves," (Lecture III.)

Mechanical Engineers, Storey's Gate, Westminster, S.W., 8 p.m. (Graduates' Section.) Mr. A. W. Waddy, "Notes on Organisation in Small Engineering Works."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. J. Done, "Valuations for Mortgage."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Reading of the "Gunning" Prize Essay.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. E. T. Reed, "With Pen and Pencil, and a Sense of Humour."

TUESDAY, DEC. 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Louis N. Parker, "Hisiorical Pageants."

Hellenic Studies, in the Rooms of the Society of Antiquaries, Burlington-house, W., 5 p.m.

Faraday Society, 92, Victoria-street, S.W., 8 p.m. 1. Mr. James Swinburne and Dr. G. Rudorf, "The Physics of Ore Flotation" (with Experiments). 2. Professor A. K. Huntington, "The Concentration of Metalliferous Sulphides by the Flotation Process" (with Experiments). 3. Professor James Walker, "The Ions of Pure Water."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on paper by the Hon. Charles Algernon Parsons and Mr. George Gerald Stoney, "The Steam-Turbine."

Photographic, 66, Russell-square, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m., Mr. E. B. Osborn, "The Future of Western Canada."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8p.m.

WEDNESDAY, DEC. 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. F. Mitchell, "The Commerce and Industries of Japan,"

Association of Engineers-in-Charge, St. Bride's Institute, Fleet-street, E.C., 8 p.m. Mr. J. W. Blakey, "High Pressure Gas Illumination."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, DEC. 14....SOCIETY OF ARTS, John-street, Adelphi, W.C. 4½ p.m. (Colonial Section.) The Hon. Rodolphe Lemieux, "Glimpses of Canada."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Cecil J. Sharp, "English Folk Song."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. W. H. Patchell's paper, "The Charing-cross Company's City of London Works."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Tramways and Light Railways Association, 3 p.m., visit to Lots-road Power Station, and at the HOUSE OF THE SOCIETY OF ARTS, 8 p.m. Mr. Elmer E. Cook, "Improvements in Trucks."

FRIDAY, DEC. 15...Aeronautical (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. 1. Miss Gertrude Bacon, "The Acoustical Experiments carried out in Balcoms by the late Rev. J. M. Bacon." 2. Mr. F. Webb, "The Aeromobile." 3. Mr. W. Cochrane, "A New Continuous Impulse Petrol Motor for Dynamic Flying Machines."

Civil Engineers, 25, Great George street, S.W., 8 p.m. (Students' Meeting.) Mr. E. E. Mann, "Tests of Street Illumination in Westminster."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper, on "Inscriptions."

Architectural Association, 18, Tufton-street Westminster, S.W., 7½ p.m. Mr. W. H. Bidlake, "Church Towers and Spires."

Junior Institute of Engineers, Westminster Palace Hotel, S.W., 8 p.m. Professor John T. Morris, "Electrical Mains for Power Transmission Work."

Quekett, Microscopical Club. 20, Hanover-square W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Dr. H. C. H. Carpenter, Mr. R. A. Hadfield, and Mr. Percy Longmuir, "The Properties of a Series of Iron-Nickel-Manganese-Carbon Alloys." 2. Mr. E. G. Izod, "Behaviour of Materials of Construction under Pure Shear."

Physical, Royal College of Science, Exhibition-road, South Kensington. Exhibition of Electrical, Optical, and other Physical Apparatus, from 7 to 10 p.m.

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FRIDAY, DECEMBER 15, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 18, 8 p.m. (Cantor Lecture.) DR. J. A. FLEMING, D.Sc., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (Lecture IV.)

WEDNESDAY, DECEMBER 20, 8 p.m. (Ordinary Meeting.) CHARLES L. BURDICK, "The Aerograph Method of Distributing Colour."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, at 7 o'clock, by PROFESSOR HERBERT JACKSON, F.I.C., on "Flame and Combustion."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

CANTOR LECTURES.

Dr. J. A. FLEMING, F.R.S., delivered the third lecture of his course on "The Measurement of High Frequency Currents and Electric Waves" on Monday evening, 11th inst.

The lectures will be published in the *Journal* during the Christmas recess.

APPLIED ART SECTION.

Tuesday evening, December 12; SIR MARCUS SAMUEL, BART., Vice-President of the Society, in the chair. The paper read was on "Historical Pageants," by LOUIS N. PARKER, F.R.A.M.

The paper and report of the discussion will be published in the number of the *Journal* for December 22.

COLONIAL SECTION.

Thursday afternoon, December 14; The RT. HON. LORD STRATHCONA AND MOUNT ROYAL, G.C.M.G., in the chair.

The paper read was "Glimpses of French Canada," by the HON. RODOLPHE LEMIEUX, K.C., Solicitor-General of Canada.

The paper and report of the discussion will be published in the number of the *Journal* for January 5, 1906.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday evening, December 7th, 1905; The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., in the chair.

The paper read was—

THE PARTITION OF BENGAL.

By SIR JAMES BOURDILLON.

When I had the honour of being invited to read the paper which stands against my name this afternoon, I received the intimation with no little misgiving, for two reasons. In the first place, this is the first occasion on which I have had the honour of addressing an audience composed of the members of this distinguished Society and their friends; secondly, I was deeply conscious that, if I undertook the task, I should find among my hearers many who can lay claim to a wider and more profound knowledge of Indian affairs than I possess, and others who entertain strong opinions on the subject of my paper antagonistic to the views that I hold myself. But the invitation to address you was in itself so great a compliment, and was so cordially worded, that I felt it would have been ungracious to refuse.

I shall endeavour, therefore, this afternoon to explain to you as well as I can what the Partition, or rather the Reconstitution of Bengal really is, why it has been carried out, what are the opinions entertained in regard to it, and what the effect of it is likely to be; I shall endeavour not to be too technical on the one hand, or too general on the other, and if I err in either direction, I trust that the gentlemen who will take part in the discussion after my paper has been read will do their best to correct these errors.

Let me first say a few words about the geographical and physical features and the history of the great province of Bengal, and give you a few statistics, since without these it will be difficult for you to understand the observations which will follow.

The name Bengal, or Bangala, originally applied to the deltas of the Ganges and Brahmaputra rivers, and to a portion of the plains to the north of this delta, and this is still the application of the word as used by the people of the country. But after the establishment of the British power in India the name was used much more loosely. The early factories of the East India Company in north-eastern India were all regarded as being in Bengal, as distinct from Bombay or Madras, and the use of the name extended with the influence of the Company until the official designation, "the Presidency of Fort William in Bengal," covered the whole of the British conquests in Northern India. In the end, however, the unwieldy size of the Bengal Presidency rendered its sub-division necessary, and the application of the name was again narrowed. Bengal, as one of the nine great provinces into which India under British administration is now divided, was made up, until the other day, of the territories which constitute the Lieutenant-Governorship of Bengal, including the Native States which are in political dependence upon that Government, and it is to that area that I shall refer in the descriptive remarks which follow.

The Province of Bengal, as thus constituted, is, on the whole, a compact territory. It lies at the head of the Bay of Bengal, extending chiefly north and north-west from its coast-line, which runs from the river Náf on the east side of the bay to the Chilka Lake on the west side. The province is situated partly within and partly without the tropics, being, roughly speaking, divided into two equal parts by the Tropic of Cancer, and it covers $8\frac{1}{2}$ degrees of latitude and $12\frac{1}{2}$ of longitude. It is bounded on the north by Nepal, Tibet, and Bhutan; on the east by the British provinces of Assam and Burma; on the south by the Bay of Bengal and the Madras Presidency; on the west by the Central Provinces, the States of the Central India Political Agency, and the United Provinces of Agra and Oudh.

Bengal is divided into four sub-provinces of very unequal size, viz., Bengal Proper, Behar, Orissa, and Chutia Nagpur. This division of the country is a natural one, and corresponds very closely with its ethnological and linguistic characteristics. Bengal Proper is rather more than the Bangala of ancient times, the country known as Bengal by the natives of India, where the Bengali language is spoken. Orissa and Behar were distinct provinces under Mohammedan rule, and the former retained its independence until comparatively recent times under successive dynasties of Hindu kings.

Oriya and Hindi are the respective vernaculars of these provinces. Chutia Nagpur, inhabited by semi-civilised hill-tribes of aboriginal race, was, until even a late period, considered as outside the pale, and was known to the Mohammedans as *Jharkhand*, or the jungle country.

These great divisions of the province differ as widely from each other in physical characteristics as they do in the language and races of their inhabitants. Bengal Proper is a flat country, of rich alluvial soil, for the most part producing great crops of rice and other products which require abundant rainfall; its climate is warm, moist, and enervating, and its people are of delicate physique. Behar is composed of wide plains stretching gently upwards from the Ganges, on the north to the lower slopes of the Himalayas, on the south to the foot hills of the Chutia Nagpur system, and to the outer spurs of the plateaux of Central India. The climate is dry and bracing, the products of the soil more varied, and the people more hardy and of better physique. Orissa consists of a strip of low land lying between the mountains and the sea, and intersected by the courses of mighty rivers; its more southerly position gives it a hotter and drier climate than that of the rest of Bengal. Chutia Nagpur is, for the most part, a wide area of mountain and forest of great beauty and luxuriance, interspersed with stretches of rich cultivation; its elevation renders the climate agreeable throughout the year; it is largely inhabited by aboriginal peoples, and it possesses great mineral wealth.

More than half of Bengal consists of alluvial plain, formed of silt, which has been brought down by the great rivers. Throughout this portion of the province, except when we approach the hills, nothing so coarse as gravel is found; the ground to a great depth consists of sand, clay, and like materials, and the surface, wherever it is flooded during the rainy season, receives great deposits of mud, which render the soil inexhaustibly fertile.

The river system of Bengal is the most important feature of its physical geography, and a knowledge of it provides a key to the history of the province, and is essential to the proper understanding of that history. Its great rivers have always formed natural boundaries; in old days they were practically the only means of communication except narrow paths through endless swamps, and interminable forests, which at best could only be traversed in the fair weather season; later on they became the great arteries of trade and commerce. This characteristic they retain to the present day, in spite of the competition of the railways, while their teeming waters provide the food of millions of the people. With a climate so mild, and a soil of such inexhaustible fertility, magnificent crops of cereals are everywhere assured, provided that the rainfall is timely and sufficient. Owing to their situation with reference to the force and direction of the winds which bring up the periodical monsoons, most of the districts of Bengal are practically safe from a failure of the harvest; it is only in the west and south-west of the province that scarcity need ever be apprehended. Rice is the staple crop, and it is estimated that of the arable land of the province 57 per cent. is under rice. In the higher and drier lands all the cereals of Europe grow freely, such as the millets and pulses, wheat, barley, oats, and maize. Other important crops are sugar-cane and indigo, the opium poppy, tobacco, tea, and the mulberry; fibre plants are represented by cotton and jute, of which Bengal enjoys a practical monopoly, while numerous kinds of oil seeds are produced in vast quantities.

As regards mineral products the most important is coal, which occurs chiefly in the north-eastern border of Chutia Nagpur, and in the western part of Central Bengal. Iron ore is found in various parts of the province, as well as copper and gold in small quantities, while mica occurs in Chutia Nagpur and Behar.

At the present day the whole country directly under British rule is divided into forty-seven Districts, each of which has its administrative officials, under a district officer, who, save in a few districts, is termed the Collector. Several Districts grouped together form a Division, which is under a Commissioner, who is directly subordinate to the Board of Revenue and to the Government. There are nine such Divisions, of which five are in Bengal Proper, and two in Behar, while Orissa and Chutia Nagpur each form a complete Division. Besides Orissa and Chutia Nagpur, which will be referred to later in this paper, the Divisions with which we are at present concerned are those of Chittagong and Dacca in the east of the province, and that of Rajshahi in the north.

The total area of the province is 189,837 square miles, of which far the larger part is under the direct administration of the Lieutenant-Governor, only 38,407 square miles

being included within the Native States attached to the province.

It is thus the largest of the political and administrative divisions of India, the next to it being Bombay, with its attached States, with an area of 188,825 square miles. But these bald figures give little information, and it will be easier to appreciate the dimensions of this great province if we remember that it is almost the same size as Spain, a little smaller than France, and nearly 40 per cent. larger than the whole of the British Isles. Bengal Proper is half as large again as England and Wales, and exceeds in area the aggregate of five European States, viz., Denmark, Holland, Belgium, Switzerland, and Greece; Behar is nearly as extensive as the new kingdom of Roumania or the ancient kingdom of Poland; Chutia Nagpur is a little larger than Ceylon, and a little smaller than Bavaria; Orissa and the kingdom of Saxony are of almost equal extent; and the area of the Feudatory States is rather more than that of Portugal.

According to the Census of February, 1901, the population of Bengal was 78,493,410. This represents an average density of population throughout the province of 413 persons per square mile, whereas the average for England and Wales is 557. But while the population of England is concentrated in the great towns, that of Bengal is almost entirely rural. The total urban population of Bengal is under 4,000,000, or about 5 per cent. of the whole, of which more than a million are in Calcutta and its suburbs, and only seven towns besides Calcutta have over 50,000 inhabitants. The most thickly peopled part of the province is Central Bengal, while Chutia Nagpur, with its mountains and forests, has the lowest average density.

Of the total population in 1901 the Hindus numbered about two-thirds, or 49,687,362, and the Mohammedans were about one-third, or 25,495,416. Under the head of Animistic religions, that is the primitive faiths of the so-called aboriginals of Chutia Nagpur and elsewhere, were classed 2,780,460 persons. The balance of the population was made up of Christians, Buddhists, and other smaller religious communitfes.

The distribution of the two principal religions is a matter which is interesting in itself and is important in connection wlth the question we are discussing to-day, viz., the partition of the province. In five out of the nine Divisions of the province the Hindus greatly outnumber the Mohammedans; the remaining four Divisions are those of the Presidency (or Metropolitan Division), Rajshahi, Dacca, and Chittagong. In the Presidency Division the numbers of Hindus and Mohammedans are about equal; in the Rajshahi Division the proportion is 5 to 3, and in the Dacca and Chittagong Divisions the Mohammedans outnumber the Hindus by more than two to one.

Bengali is the mother tongue of more than half the population, and is that spoken throughout the three Divisions which I have just mentioned; Hindi is the mother tongue of about one-third of the population, or twenty-six and a quarter millions; while Oriya is the mother tongue of about six millions.

I have said already that Bengal is almost entirely an agricultural province, and the latest census returns show that 72·5 per cent. of the people are engaged in agriculture and landed pursuits. The great majority of the peasant class cultivate small holdings, in which they have tenant rights which can be disposed of, under certain legal restrictions, and can be passed on by succession.

The material condition of the people is by far the best in Northern and Eastern Bengal, which areas, I may remark again, include the districts affected by the reconstruction of the province—and in many of the districts of this area the peasantry are certainly prosperous. The land there is less densely populated, wages are higher and food cheaper, while in them the rainfall is both more copious and more regular, while some of the staple crops—jute, tobacco, and rice—command a higher price, relative to the rent of the land, than the crops in other parts of the province. In Behar, with its teeming population, and its more precarious rainfall, the peasantry are not so well-to-do; rice is not the common staple food of the poorer classes, its place being taken by cheaper grains—such as maize, the millets, barley, and peas. Moreover, until quite recent times, the people were backward and ignorant of their rights, and the landlords had more than their fair share of power and influence.

Having thus briefly described the principal physical and geographical features of the Province of Bengal, let me say a very few words as to its history.

From the death of the great Asoka, the Buddhist Constantine, in the year 226 B.C., until the formation of the Gupta empire at the beginning of the fourth century of the Christian era, five centuries elapsed, and for this

long period our knowledge of the history of Northern India is extremely meagre. But from the fourth century of our era onwards the information is fuller, and the light grows clearer, until, with the Mohammedan invasions under Mahmud of Ghazni, which commenced in 1001 A.D., we leave the region of tradition and conjecture, and enter upon the field of ascertained facts and chronological accuracy.

The meagre records which I have referred to throw little light upon the history of Bengal during this early period: the western parts of the province were undoubtedly included in the kingdoms of the Mauryas, whose capital was Patna, and of the Guptas, who ruled in Magadha, but of Central and Eastern Bengal we know almost nothing. It is certain, however, that a dynasty of Pala kings, professing or tolerating the Buddhist religion, rose to power about the middle of the ninth century, and, after driving out the Guptas from Behar and Western Bengal, reigned for two centuries; that they in turn were conquered, some time in the eleventh century, by a Sena dynasty, who ruled Bengal till they succumbed to the Mohammedans at the beginning of the thirteenth century. As regards Orissa the first glimmering of authentic history is obtained in 473 A.D., when the Yavanas were expelled by Jayati Kesari, who established a dynasty which endured for 650 years; in 1131 A.D. their capital was taken by a prince of the house of Ganga Vansa, whose dynasty occupied the throne until shortly before the conquest of the province by the Mohammedans in the middle of the sixteenth century.

As has been stated already, Bengal was first occupied by the Mohammedans at the beginning of the thirteenth century, and for more than five and a-half centuries, *i.e.*, from 1202 A.D. till the year 1765, when Clive obtained the grant of the Dewani for the British, the province remained under Mohammedan rule. During the first century of this period the province was governed by viceroys on behalf of the Pathan Emperor at Delhi; then followed two hundred years of independence, when twenty-four Sultans of Bengal, having thrown off their allegiance to the Court at Delhi, reigned in succession at Gaur and Panduah in what is now the district of Maldah; a short period of Afghan rule followed, which was terminated in 1576 when Akbar's general, Munim Khan, reconquered the province, and brought it once more within the limits of the great Moghul Empire of Delhi.

Under the great Emperors of the splendid Moghul dynasty, the Subah, or viceroyalty of Bengal, including Behar, but only a part of what we now call Orissa, was one of the great provinces of the Empire, worthy to be held by one of the Emperor's sons, or some great officer of his Court. But as that great Empire crumbled away, after the death of Aurangzeb in A.D. 1707, the hold of the Emperor at Delhi or Agra upon his distant Governors grew weaker, and the Subahdar of Bengal, like the Viceroy of many another province, gradually assumed a virtual independence, although he still professed loyalty to the Emperor, and remained technically and in name his subordinate and vicegerent. In the long line of Viceroys who ruled the province from Patna, Murshidabad, Dacca, or Monghyr, two names stand out with special prominence and deserve a passing notice. The first of these is Murshid Kuli Khan, a converted Brahmin, who founded the city of Murshidabad, and who was Dewan of Bengal, and eventually Subahdar of the three Provinces from 1702 to 1725. The second is Ali Verdi Khan, a Moghul by birth, who, after much service in other parts of the Empire, ruled Bengal from 1740 to 1756, and, dying at the age of 80 years, bequeathed the government to his grandson, the infamous Suraj-ud-dowlah.

Meanwhile, amid the confusion of the times, in spite of many failures and reverses, and with incredible toil and difficulty, the East India Company had laid the modest foundations of their power in Bengal. Among the many thrilling chapters which adorn the splendid story of the growth of British dominion in India, none yield in interest or pathos to that which tells of the establishment of their rule in Bengal. It would occupy far too much of our time this evening to deal with the incidents of that wonderful narrative. But we may recall to mind some of them, and remember how after the Company had gained a firm footing first in Surat and then in Madras, they made repeated attempts to establish themselves in Bengal; how they achieved no real progress till the patriotism of one of their surgeons obtained for them (in 1636) the concession of free trade and permission to build factories in the interior, as his reward for medical services rendered to the family of the Emperor; how after half a century of subsequent progress and prosperity they fell out (in 1685) with the Moghul Viceroy and three years later abandoned Bengal; how they returned in 1690 and after a reconciliation

with the Emperor settled down in Calcutta. During the first half of the eighteenth century the history of the Company in Bengal is a record of constant quarrels with the Mohammedan Viceroy at Murshidabad, and of incessant attempts by him to extort large sums from the Company, who for their part had much ado to carry on their trade without any ideas of sovereignty or dominion, or any premonition of the splendour of the centuries to come. On the contrary, they came near to being driven from Bengal altogether.

In 1756, as has been stated before, Suraj-ud-dowlah became Viceroy of Bengal, Behar, and Orissa, and before many weeks had passed he forced a quarrel upon the British which ended in the capture of Calcutta, the tragedy of the Black Hole, and the expulsion of the British from the Hooghly. There is no need to dwell on the details of this great catastrophe, which took place on the 21st of June. Before the end of the year Clive led an expedition from Madras up the Hooghly to relieve the fortunes of the Company in Bengal, and to attack the French settlement in that province. On the 23rd June, 1757, within two days of the anniversary of the loss of Calcutta, Clive defeated the Nawab's army at Plassey, and founded the British Empire in Upper India. The change effected by this short campaign in the position and prospects of the British was so rapid and stupendous as almost to exceed belief; within six months they had recovered their capital, extinguished their European rivals, defeated and dethroned the Nawab, the Emperor's viceroy, had disposed of the government of the three provinces to their own partisan, and had levied a war indemnity of £2,500,000 sterling.

But while Clive was thus giving away a kingdom larger and more populous than England, he reserved for his own masters only the fee-simple of the land six hundred yards around the Mahratta ditch, and the rights of a landlord in a small tract of country lying south of Calcutta. The idea of empire and dominion was not yet born, and the British in India were still only a trading company, fighting for self-defence and existence, and struggling with the trading companies of other nations for exclusive commercial rights.

Upon the departure of Clive in 1760, differences soon arose with the Court of Murshidabad, and the Company deposed their first nominee, Mir Jafir, in favour of his son-in-law, Mir Kasim, who, as the price of his elevation to the post of Subahdar, ceded to the Company three districts which were then estimated to furnish one-third of the revenue of Bengal, and which formed the nucleus of the Company's territorial possessions in Upper India. But the harmony between the British and the new Viceroy was of short duration, and they found themselves by the end of 1764 at war with the Nawab, and involved with the Emperor himself and the Nawab Wazir of Oudh. The disorders of the time were so great that in 1765 Lord Clive returned to Calcutta, entrusted with the prodigious task of purifying the administration, arranging the difficulties of the Company, and placing its affairs and its government upon a firm basis. Within three months he had achieved the first of these tasks, and had, on behalf of the Company, obtained from the Emperor of Delhi a firman, or order, transferring to them the Dewani of Bengal, Behar, and Orissa. That is to say, the Emperor surrendered to the Company the complete fiscal and revenue control and the government of three provinces with a population of 25,000,000 souls, and a revenue of £4,000,000 sterling; the Company in return accepted annual charges of half-a-million to be paid to the Nawab of Murshidabad, and a quarter-of-a-million to the titular Emperor of Delhi. On that day, the 12th August, 1765, the British entered upon that career of conquest and dominion, which, though often undertaken against their will, has made them at last masters of the Continent of India.

From that day also the history of Bengal has been the history of the British power in India. It is unnecessary for me to follow it further, or to explain the gradual accessions of territory which eventually caused the term the Bengal Presidency to be applied to an ever-increasing area, most of which had in fact no connection with the maritime province in the East, which gave its name to the whole. As time passed, the administration of these ever-increasing territories imposed a heavier burden upon the Governor-General, but nevertheless he retained his connection with the old province, inasmuch as he remained not only Governor-General of India, but also Governor of Bengal. Whenever his duties called him away from Calcutta, the reins of provincial government were committed to a Deputy-Governor, who was usually the senior member of his Council, and he controlled the province during the absence of the Governor-General. This arrangement continued in force for ninety years, until, in 1854, in the time of Lord Dalhousie, the Province of Bengal was made a separate and independent charge, and

was committed to the control of a Lieutenant-Governor.

The province, as then constituted, was actually larger than that which had been held by the Mohammedan Viceroy of Bengal, Behar, and Orissa, for it included part of Orissa which had been held by the Mahrattas till 1803, a portion of Assam which had never really come under Mohammedan rule, and much wild country in Chutia Nagpur and the Native States which appertain to it, which was practically beyond the reach of the native officials of the Murshidabad Court. Such as the province was in 1854 it has continued till the present day, with two exceptions. The Province of Assam was separated from Bengal in 1874, and constituted a separate administration under a Chief Commissioner, and in 1898 the district of the South Lushai Hills was added to Assam: now after thirty years it has been decided to continue the process of separation which was then inaugurated, and by welding together the small province of Assam and the easternmost Divisions of Bengal to build up a great Eastern province under a Lieutenant-Governor, which shall be little inferior in size, population, and importance to the remains of the great province from which it has been carved.

Lastly, it will be of interest to compare the Province of Bengal with the three other large provinces of the Indian Empire, in respect of their area, their population, and their provincial expenditure. This comparison is made in the following table:—

Province.	Area in square miles.	Population in 1901.	Provincial expenditure (in lakhs of rupees).
Bengal	189,837	78,493,410	5,38
Madras	151,695	42,397,522	3,81
Bombay	188,825	25,468,209	5,15
United Provinces of Agra and Oudh	112,243	48,493,879	4,15

The figures show that in respect of all these matters Bengal is the largest of them all, and it need hardly be said that in consequence of this pre-eminence the volume of work to be got through in Bengal is greater than it is in any other province of the Empire.

Let me now proceed to explain how the proposal to reconstitute the province came to be brought forward, and what shapes and dimensions that proposal has assumed in the various stages through which it has passed.

No person who has been associated with the Indian Empire during the Viceroyalty of Lord Curzon, and no one who has taken an interest in Indian affairs during that strenuous time, can fail to remember that he went out to his high post full of plans for the improvement of the administration, and for the amelioration of the condition of the people of India; also, that as time passed, more and more reforms were included in his programme as they approved themselves to his judgment and to that of his colleagues in the government of India. Prominent among these later questions was the re-adjustment of the boundaries of provinces which seemed to be either too small on the one hand, or too unwieldy on the other, for efficient administration according to the high standard which His Excellency desired everywhere to set up.

During the year 1902, the Government of India carried to a conclusion the negotiations for the cession of Berar by His Highness the Nizam of Hyderabad, and for the amalgamation of that territory with the administration of the Central Provinces. During the following year the reconstitution of Bengal, which had been talked of while the Government of India were in Calcutta, was further discussed at Simla, and the general lines of the measure were settled during the summer of 1903. The scheme itself was launched in a letter from the Government of India to the Government of Bengal, dated December 3rd of that year, and I cannot do better than read the opening paragraphs of that communication, which state the case for the Supreme Government, and show why it was that they were led to undertake the reconstitution of the province as a grave administrative necessity.

"As long ago as 1868 Sir Stafford Northcote drew attention to the greatly augmented demands that the outlying portions of Bengal appeared to make on the time and labour of those concerned in the government of the province. He referred to the famine of 1866 as furnishing evidence of the defects of the existing system of government when exposed to the ordeal of a serious emergency, and, among other methods of relieving the overtasked administration, he suggested the separation from Bengal proper of Assam and possibly of Orissa. In the discussions that followed the question was very thoroughly examined by a number of high authorities, and eventually it was decided that Orissa should remain attached to Bengal, but that Assam proper and certain other districts on

the north-eastern frontier of Bengal should be formed into a separate Chief Commissionership directly under the Government of India. At the time when this decision was arrived at the population of Bengal as then constituted was believed to be between 40 and 50 millions. The Census of 1872 showed it to be nearly 67 millions. With these figures before him Sir G. Campbell said, as Sir William Grey had said five years before, that the territories under the Lieutenant-Governor of Bengal were more than one man unaided could properly govern. Since then the population of Bengal, as it now stands, has risen to 78½ millions, and this increase has been accompanied by a considerable development of the material resources of the country, and a great extension of railways and other means of communication, while the spread of English education and the wider diffusion of the native press tend to increase litigation, to demand more precise methods of administration, to give greater publicity to the conduct of officials, and in every way to place a heavier strain upon the head of the Government and upon all ranks of his subordinates. In the opinion of the Government of India the time has come when the relief of the Bengal Government must be regarded as an administrative necessity of the first order. And that relief can be afforded, not, as has been suggested on several previous occasions, by organic changes in the form of government, but only by actual transference of territory. It is unnecessary to refer to the circumstances which have brought about the great concentration of peoples (with a corresponding growth of administrative problems) in the deltaic regions that constitute the greater part of Lower Bengal. The fact is sufficient that at the present time the Lieutenant-Governor of Bengal is called upon to administer an area of 189,000 square miles (151,000 British territory) with a population of 78,493,000 (74,744,000 in British territory), and a gross revenue of 1,137 lakhs (land revenue 505 lakhs).

"The Government of India believe it to be beyond dispute that this is too heavy a burden for any one man, and that it cannot be adequately discharged save at the expense of efficiency. A Lieutenant-Governor of Bengal, if he spent the whole of the available season of the year in touring, could yet only succeed, during his term of office, in visiting a portion of his vast charge. As a matter of fact, it will commonly be found that places so important as Chittagong, Dacca, Cuttack, and Ranchi receive not more than a single hurried visit within the five years. The Lieutenant-Governor is generally expected to be in Calcutta during the winter months, from November to April, and there his time is taken up not only by social duties, which are onerous and which tend continually to increase, but by official or ceremonial functions in which he is called upon to play a leading part; while personal interviews occupy a large portion of his time. He is only able to undertake short and hurried excursions in his province at this, which is the most favourable season of the year; and the time that he devotes to his departments and to provincial administration is constantly being encroached upon by great municipal and other problems. In the remaining seasons of the year he is unable to make up the deficit for which Calcutta has been responsible. The result of both these features, viz., the hurried and necessarily incomplete tours of the Lieutenant-Governor through his province, and his overwhelming pre-occupations while he resides in the capital, is that in Bengal the work of government has come to be less personal in its character than in any other Indian administration. Anywhere in India this would be a grave defect, but it is worst of all in a province where already, owing to the existence of the Permanent Settlement, there is wanting that link of close knowledge and mutual understanding between the district officer and the people that is supplied by an intimate familiarity with the Land Revenue settlement and administration. Thus in the province where personal rule is perhaps most required, there is least of it, and where the officers know least of the people, the Government knows least of its officers. This is a state of affairs that cannot be revolutionised in a moment, and perhaps cannot be revolutionised at all. But the one course that is practicable is to reduce the gravity of the mischief by curtailing its extent, and to afford the opportunity for increased contact between the administration and the people by easing the former's burden. Already in 1874 the same line of reasoning led, in spite of many contemporary protests, to the severance of Assam from Bengal. The result has undoubtedly been beneficial to both parties, and the experiment has been justified. The time has now come when it should be repeated on a larger scale. No question of loss of prestige or even of temporary sacrifice of advantage ought to stand in the way of a statesmanlike and far-sighted handling of the question. As in 1874, the main criterion of the action of Government should be the good of the districts and the people whom it is proposed to transfer, but behind this stands the paramount consideration that tranference on a large scale has become an absolute necessity."

Having thus opened the case the letter goes on to explain the means which it was proposed to employ in order to effect the transfer of territory from Bengal to the best possible advantage. By these proposals it was intended to curtail the limits of the province in three directions, viz., those of the Central Provinces, Madras, and Assam, and they were as follows:—

(*a*) The Chutia Nagpur Division, with the tributary States attached to it, was to be transferred to the Central Provinces, with the exception of one, or perhaps two districts, and possibly of certain tracts where Oriya was the native tongue of the inhabitants.

(*b*) As to Orissa, the whole of the Oriya-

speaking peoples were to be united and placed under the Lieutenant-Governor of Bengal by adding to the Orissa Division certain portions of the Madras Presidency, and certain tracts which were to be taken over from the Central Provinces.

(*c*) Lastly, the Chief Commissionership of Assam was to be enlarged by the addition to it of the Chittagong Division, with the State of Hill Tipperah, as also the two districts of Dacca and Mymensingh in the Dacca Division. According to this proposal, the boundary between Bengal on the west and Assam on the east would have been the great Brahmaputra river, known locally at the end of its course as the Padma.

The net result of these transfers, so far as Bengal and Assam are concerned, would have been as follows:—

Bengal.

Present population		78,493,410
Deduct losses	15,462,561	
Add gains	4,469,635	
Deduct net loss		10,992,926
Future population		67,500,484

Assam.

Present population............	6,126,343
Add gains from Bengal........	11,475,646
Future population	17,601,989

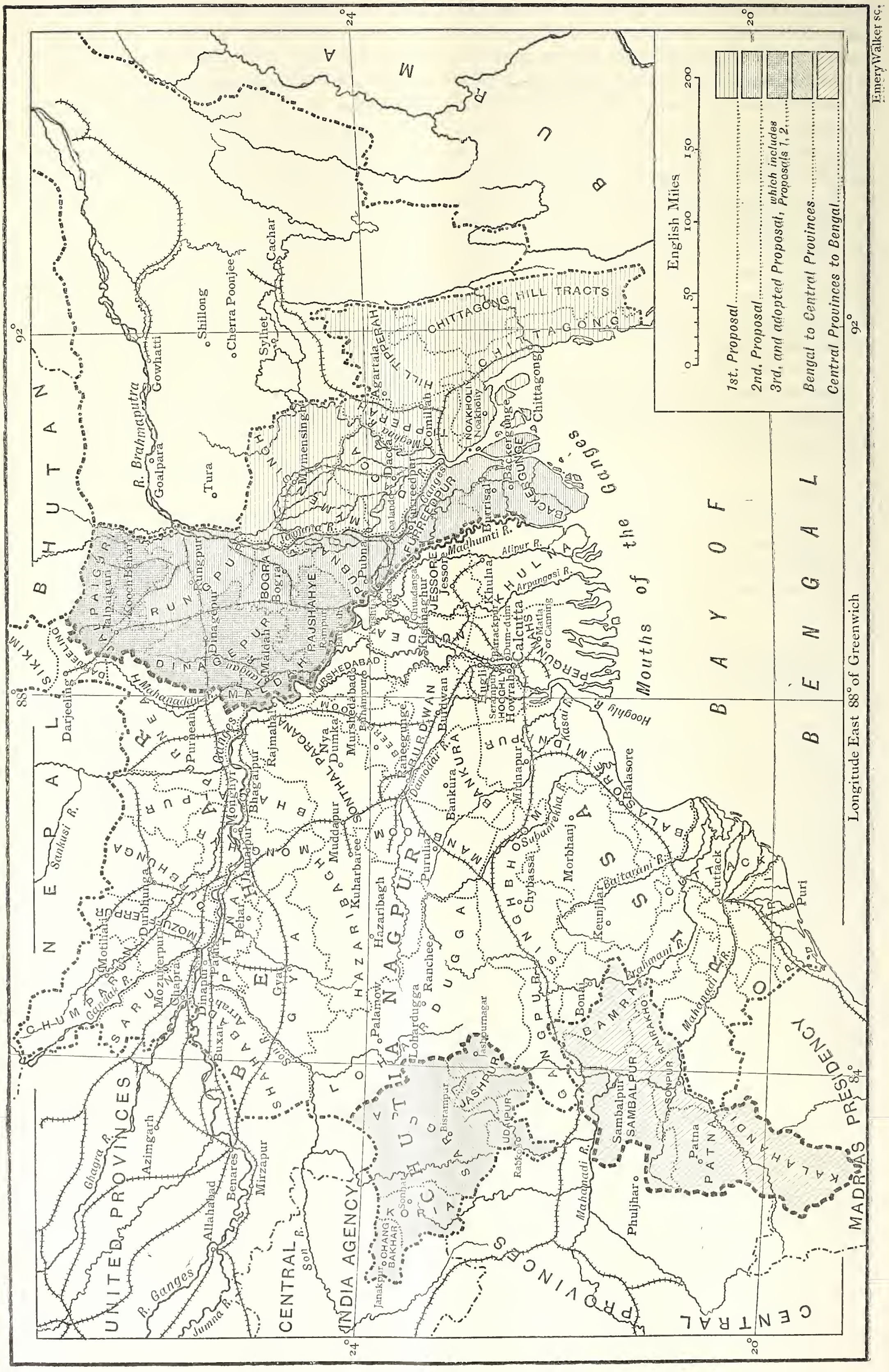
When these proposals became known to the public, they evoked a storm of opposition which, though most violent in Bengal, was shared by Orissa, and Madras also, and they were vehemently condemned both in principle and detail. The press, both native and European, but especially the former, took up the question with fervour, meetings were held, memorials submitted, and demonstrations organised to protest in the most emphatic terms against the disruption of the Bengali nation, against the transfer of some of the most important districts to a backward province like Assam, and to the wholesale destruction of liberties and privileges to which the people had long been accustomed. In February, 1904, His Excellency the Viceroy made a tour through Eastern Bengal, from which quarter and from Calcutta the most vehement opposition was experienced, and in reply to addresses presented to him *en route* he delivered three long speeches at Chittagong, Dacca, and Mymensingh, in which he dealt at length with the opposition to the proposed reconstruction of the province. Later, on the 18th March, 1904, a public meeting was held in the Town Hall in Calcutta, at which most of the principal zamindars of Bengal and leading Hindus of Calcutta were present, in person or by proxy; strongly-worded resolutions were passed and signed by many influential men, which were submitted to the Government of India, and were followed, later in the year, by a memorial based on those resolutions, but developing the views of the memorialists at greater length.

Meanwhile, the proposals of the Government of India were subjected to careful and prolonged scrutiny by the different Governments concerned, who not only examined them from the official point of view, but also sought the advice of all those, whether individuals or associations, who, it was thought, were likely to be able to offer useful criticism, or a matured opinion on the subject.

It soon became apparent that the proposals as regards Madras were very distasteful to almost all concerned, and that they offered no substantial advantages; they were strongly opposed by the Government of Madras, while they received little or no support from the Government of Bengal, and, to anticipate somewhat the march of events, they were eventually abandoned and need not again be referred to.

Considerable feeling was evinced also against the proposal to transfer Chutia Nagpur *en bloc* to the Central Provinces, and the transfer was opposed not only by the inhabitants of the Chutia Nagpur Division, but also by the commercial community of Calcutta, who represent large interests in the railways and in the development of the mineral wealth of the Division, of which coal is the chief product. The Lieutenant-Governor, after a tour in Chutia Nagpur, took the same view, and in the end all that has been effected in this direction has been an exchange of territory as shown in the map, by which all the Hindi-speaking States of Chutia Nagpur have been transferred to the Central Provinces, in the east of which Hindi is the language of the people, while, on the other hand, one British district, and five Native States, in which Oriya is the vernacular of the people, have been transferred from the Central Provinces to Bengal, and added to the Orissa Division.

The discussions on these two proposals, however, were merely ancillary to the great controversy which raged round the central proposal, to transfer from Bengal certain of its districts and amalgamate them with Assam, and to this question I will now address myself.


English Miles
0 50 100 150 200
1st. Proposal
2nd. Proposal
3rd, and adopted Proposal, which includes Proposals 1, 2.
Bengal to Central Provinces
Central Provinces to Bengal
Longitude East 88° of Greenwich
BAY OF BENGAL
Mouths of the Ganges
NEPAL
BHUTAN
SIKKIM
BURMA
UNITED PROVINCES
CENTRAL INDIA AGENCY
CENTRAL PROVINCES
MADRAS PRESIDENCY
CHITTAGONG HILL TRACTS
CHITTAGONG
HILL TIPPERAH
NOAKHOLLY
BACKERGUNGE
FURREEDPUR
DACCA
MYMENSINGH
PUBNA
BOGRA
RAJSHAHYE
RUNGPUR
JALPAIGURI
DINAGEPUR
MALDAH
MURSHEDABAD
NUDDEA
JESSORE
KHULNA
PERGUNNAHS
HOOGHLY
BURDWAN
BANKURA
MIDNAPUR
BALASORE
CUTTACK
PURI
SAMBALPUR
PATNA
KALAHANDI
SONPUR
BAMRA
RAIRAKHOL
UDAIPUR
JASHPUR
CHANG BAKHAR
SANTHAL PARGANAS
MANBHUM
SINGHBHUM
HAZARIBAGH
LOHARDUGGA
Calcutta
Howrah
Dacca
Chittagong
Darjeeling
Shillong
Cherra Poonjee
Gowhatti
Goalpara
Tura
Sylhet
Cachar
Agartala
Comillah
Burrisal
Jessore
Khulna
Kishnaghur
Bogra
Rampur
Dinagepur
Maldah
Rungpur
Jalpaiguri
Kooch Behar
Purneah
Bhagalpur
Monghyr
Rajmahal
Dumka
Murshedabad
Berhampur
Burdwan
Raneegunge
Bankura
Midnapur
Balasore
Cuttack
Puri
Keunjhar
Morbhanj
Chybassa
Purulia
Ranchee
Hazaribagh
Kuharbaree
Palamow
Gya
Behar
Patna
Dinapur
Arrah
Buxar
Chapra
Mozufferpur
Durbhunga
Motihari
Benares
Mirzapur
Allahabad
Azimgarh
Sambalpur
Phuljhar
Janakpur
Sonhat
Jashpurnagar
Bistrampur
Rabkob
Bonai
R. Brahmaputra
R. Ganges
Jumna R.
Ghagra R.
Sankusi R.
Gandak R.
Soan R.
Damodar R.
Hoogly R.
Subanrekha R.
Baitarani R.
Brahmani R.
Mahanadi R.
Madhumti R.
Alipur R.
Arpangosi R.
Jamuna R.
Megna R.
Emery Walker sc.

The main object of the Government of India as set out in their first letter was to relieve the Lieutenant-Governor of Bengal of part of his burden, and the addition of territory to the province of Assam appeared as a mere incident of that relief; instead of proposing boldly to slice off a large piece of Bengal and add it to Assam, their letter of the 3rd December, 1903, suggested the whittling away of Bengal territory in two directions, to so modest an extent that the relief to the administration in terms of population would only have been 11,000,000, and the Lieutenant-Governor would still have been left with the control of more than 67,000,000 of people. But the discussion which was elicited by the suggestions indicated to the Government of India that their proposals were not large enough, if satisfaction were to be given to the feelings of those who were alarmed at the possible deprivation of privileges which they had long enjoyed, and to which they attached a not unnatural value. Consequently, in his speeches in Eastern Bengal, His Excellency the Viceroy foreshadowed the willingness of the Government of India to consider a wider scheme, involving the creation of a Lieutenant-Governorship with a legislative council and an independent revenue authority, and the transfer of so much territory as would be required to justify the institution of so highly organised and fully equipped an administration.

It fell to the Lieutenant-Governor of Bengal to give to this wider scheme official existence, and to submit it for the consideration of the Government of India in a concrete form. His views were propounded in a long and elaborate letter, which was addressed to the Supreme Government on April 6th, 1904. In this communication, Sir Andrew Fraser reviewed, in detail, the proposals of the Government of India, and dealt with the objections which had been urged against them, as well as against the proposals which had been developed at a later date. He disapproved of the suggestions affecting Orissa and recommended considerable modifications in those which concerned Chutia Nagpur.

As regards the transfer of territory from Bengal to Assam he not only accepted the proposal that the Chittagong Division should be made over to Assam with the State of Hill Tipperah and the districts of Dacca and Mymensingh in the Dacca Division, but he advocated further the transfer of the remaining two districts of the Dacca Division, and, in addition, recommended that three districts of the Rajshahi Division, viz., Pubna, Bogra, and Rangpur, should be made over at the same time. His grounds for making this larger recommendation were, that the transfer of these five additional districts would afford substantial relief to the Government of Bengal, that they were practically of the same character as those of the Chittagong Division, and that they could, with much advantage, be amalgamated with Assam, and would thus enable the Government of India to create a new province with the status of a Lieutenant-Governorship. The effect of this second proposal, had it been carried out, would have been to reduce the population of Bengal by some 20 millions—to about $58\frac{1}{2}$ millions instead of $78\frac{1}{2}$—and the population of the new province would have been raised by the same process to $26\frac{1}{4}$ millions.

This proposal did not seem to the Government of India to be proportionate to the scope of the important administration which it was now contemplated to create, nor would it have given to Bengal, whose population would still have approached 59 millions, the permanent relief that ought to ensue from an adequate reduction of its existing area and responsibilities. Accordingly, it was proposed to increase the transferred area by the districts of Rajshahi, Dinajpur, Jalpaiguri, Malda, and the State of Cooch Behar. These additions were thought by the Government of India to be justified on the grounds that they would constitute a new province with a population of over 31 millions, while leaving Bengal with a little more than 54 millions; that they would provide a clearly defined western boundary corresponding with well-recognised characteristics, both geographical, ethnological, social, and linguistic; that they would concentrate in a single province the typical Mohammedan population of Bengal, for whom Dacca would furnish a natural capital; that the whole of the tea industry (with the exception of the Darjeeling gardens), and the greater part of the jute tracts, would thus be brought under a single Government, and that long-established divisional areas would thereby remain undisturbed. Accordingly, these proposals, which had now reached their third stage, were communicated to the Government of Bengal and the Chief Commissioner of Assam in a letter from the Government of India, dated the 18th September, 1904. They were cordially accepted by both these Govern-

ments without delay. The Lieutenant-Governor of Bengal reported that he had discussed the proposals with his most senior officers, and had found that with scarcely an exception there was complete unanimity in accepting it. The Chief Commissioner of Assam attached great value to the future association under a single Government of almost all the tea-growing areas which the new proposal would involve, and he saw in that concentration good hope for the solution of the difficult labour problem, which has long been one of the great administrative labour questions in Assam.

Before going any further, I feel compelled to pause for a moment in order to point out one undoubted flaw in the arguments in favour of transferring the whole of the Rajshahi division to the new province. No doubt it is true that the addition of this whole division to the area to be transferred will cause the population of the two provinces to be more equally divided. But it is not the case that the districts of the Rajshahi Division are ethnically and linguistically connected with those of Eastern Bengal; the truth is the exact opposite. Northern Bengal which correspond almost exactly with the Rajshahi Division, is geographically, linguistically, socially, and politically distinct from Bengal proper, the Bangala of which I have spoken at the beginning of this paper. Geographically, it is separated by the Ganges, and the Brahmaputra, and far from being a land of flat alluvial soil and innumerable streams it contains much high land of a stiff red clay, with an undulating service covered for the most part with scrub jungle. Ethnically its people are Indo-Chinese, not Indo-Aryans as in Bengal Proper. The language, though akin to Bengali, is not a daughter of it; it represents the transition of the language of Behar into that of Assam, while Bengali represents the line of change from Behar to Chittagong. Socially the people hate Bengalis; they do not call themselves Bengalis, but they employ the word to indicate a foreigner from the south, and there is always in their use of the term a ring of resentment against the clever outlander who has invaded their country and secured most of the good things in it. Again, the Northern Bengalis are Mohammedans, while the true Bengalis are Hindus, and such Northern Bengalis as call themselves Hindus really follow Indo-Chinese superstitions and worship Indo-Chinese gods. Politically, the inhabitants of Northern Bengal are simple, rather Bœotian, folk with little share in the political aspirations of the Bengalis in Southern and Eastern Bengal. It may be, as I have said, that for reasons of expediency it was well to transfer the Rajshahi Division to the new province, but let us be under no delusion that the area is homogenous with those of the Dacca and Chittagong Divisions: the only links are those of religion, and some community of language.

With the Rajshahi Division is to go the district of Maldah, which has hitherto formed part of the Bhagalpur Division. Geographically, linguistically, and ethnically, this is a proper decision, for Maldah is a Bengali-speaking district, while the language of the rest of the Bhagalpur Division is Behari-Hindi. But it is impossible for any one who knows and loves the old province and its history, to contemplate without a pang the severance of a district which contains the noble ruins of cities which were the capitals of Mahommedan Bengal for three centuries and a half, and which are full of the most splendid associations.

Another point on which the action of the Government of India is open to some criticism is this. It will be seen that these final proposals are widely divergent from those made in the original letter of the Government of India, and are considerably larger than those set out by the Lieutenant-Governor of Bengal; instead of giving to Assam one Division and two districts of another with $11\frac{1}{2}$ millions of people, it was now proposed to make over three whole Divisions with a population of 25 millions, and to surrender two-thirds of the Bengali-speaking area of the old province. Nevertheless it does not appear that this greatly altered scheme was ever officially communicated to the public. Probably the Government of India were of opinion that since the main opposition to the scheme was based upon its insufficiency, it was reasonable to assume that that opposition would be completely disarmed if the scheme were still further enlarged, and they were desirous that a question so long pending should be settled without further delay. However that may be, much exception has been taken by the opposition in Bengal to the manner in which the scheme has been dealt with in its later stages.

The conclusions thus formed by the Government of India, after such prolonged and careful examination of the question, were laid before the Secretary of State for India in a long and elaborate despatch, dated the 2nd February, 1905, and his sanction to the scheme

as thus finally framed, was conveyed in a Despatch dated the 9th June; after one or two minor points had been cleared up by telegram the decision of the Government of India was announced in a Resolution dated the 19th July. The seventh paragraph of this Resolution explains the situation with terseness and lucidity, and runs as follows:—

"The effect of the proposals thus agreed upon, and now about to be introduced, will be as follows:—A new province will be created, with the status of a Lieutenant-Governorship, consisting of the Chittagong, Dacca, and Rajshahi Divisions of Bengal, the district of Malda, the State of Hill Tipperah, and the present Chief Commissionership of Assam. Darjeeling will remain with Bengal. In order to maintain associations, which are highly valued in both areas, the province will be entitled Eastern Bengal and Assam. Its capital will be at Dacca, with subsidiary head-quarters at Chittagong. It will comprise an area of 106,540 square miles and a population of 31,000,000, of whom 18,000,000 are Muhammadans and 12,000,000 Hindus. It will possess a Legislative Council and a Board of Revenue of two members, and the jurisdiction of the High Court of Calcutta is left undisturbed. The existing Province of Bengal, diminished by the surrender of these large territories on the east and of the five Hindi States of Chutia Nagpur, but increased by the acquisition of Sambalpur and the five Uriya States before mentioned, will consist of 141,580 square miles, with a population of 54,000,000, of whom 42,000,000 are Hindus and 9,000,000 Muhammadans. In short, the territories now comprising Bengal and Assam will be divided into two compact and self-contained provinces, by far the largest constituents of each of which will be homogeneous in character, and which will possess clearly defined boundaries and be equipped with the complete resources of an advanced administration."

It only remains to add that after the issue of the necessary Order by the Governor-General in Council, and a Proclamation, these changes came into effect from October 16th last, Mr. Fuller, the Chief-Commissioner of Assam, being appointed the first Lieutenant-Governor of the new province.

Having thus briefly sketched the progress and development of this measure, from its inception in December, 1903, till it was carried into effect in October last, let us consider the grounds upon which the reconstitution of the province was based, and the objections which have been urged against it; and let us endeavour to estimate at their true value the arguments used on both sides. It will be seen as we proceed that they are not all of equal validity, and I think that I shall be able to show that some of them have no foundation in fact.

It will be remembered that the main reason put forward by the Government of India for undertaking the reconstitution of Bengal was that it was too great a charge for one man, and that, in consequence, the administration of the province was not so efficient as in other parts of the Indian Empire; stress was laid on the allegation that, owing to the various calls upon his time, the Lieutenant-Governor of Bengal has no leisure to make frequent or extensive tours, and it was asserted that "in a province where personal rule is most required there is least of it, and where the officers know least of the people the Government knows least of its officers."

With all respect to the authority from which they emanate, I take leave to say that these statements cannot be allowed to pass unchallenged, and require to be taken with some reservations. At the time when this letter of the Government of India was written the Council of the Governor-General contained, I believe, no officer who had ever served in Bengal, and, though the letter was signed as Home Secretary by a brilliant and accomplished member of the Bengal Civil Service, he would himself be the first to admit that he has little knowledge of the province at first hand, and that he is himself wanting in "that intimate familiarity with the Land Revenue settlement and administration" which can be acquired only by long service and training as a district official.

Further, this contention exaggerates the importance of personal rule in a fully advanced and developed province, and it omits to take note of the undoubted fact that much personal contact with the people is impossible in any province for the head of the administration, and is practically confined to the district officer and his subordinates. As regards the contention that the existence of the Permanent Settlement makes it unnecessary for the district officer in Bengal to know the people of his district, the answer is that it is primarily the settlement officer, and not the district officer, who is brought into contact with the people in provinces where temporary settlements are the rule. Bengal has now its Settlement Department like every other province, so that this reproach falls to the ground; while, as regards the district officers, after considerable opportunities of seeing their work in other parts of India, I assert with confidence that the district officer is every whit as efficient and as well

acquainted with his people in Bengal as he is in any part of the country.

But, on the other hand, it is true that from time to time there has been a Lieutenant-Governor of Bengal, who, for a time at least, has been unacquainted with his officers and his province, but the fault is not that of the Bengal system of administration nor of its officers. On three occasions within recent years has an officer from another province been brought in to be Lieutenant-Governor of Bengal; and capable, experienced, and laborious as they have been, they have all admitted that the task before them at the outset of their administration was stupendous. The late Sir John Woodburn repeatedly told me how hampered he had been at first by his ignorance of the province and its officers, and how deeply he felt the difficulties of his position. Had the old practice still been maintained, and had the Lieutenant-Governorship of Bengal been always given to an officer of the province, we should have heard nothing of any want of familiarity with the officials, the people, and the problems of the province, and less of the great burden of the administration.

Nevertheless, when every allowance has been made for what I believe to be overstatements in the arguments of the Government of India, the fact remains that even to an officer trained in the province, and familiarised from his youth with its problems, the burden of the Lieutenant-Governorship is immense. The volume of work to be overtaken is very great, and, as the Government of India have rightly observed, the pre-occupations of the Lieutenant-Governor in Calcutta, both social and official, are overwhelming. He and his secretaries, especially the Chief Secretary, are often compelled to work twelve or thirteen hours a day for long periods without cessation, and the strain is very great. It is undoubted that the labours of his post told severely upon the late Sir John Woodburn, and both his immediate predecessors were compelled during their period of office to take medical leave to England. In spite of this incessant labour the work to be done is achieved with difficulty, and amid the thronging claims of urgent business little time is left for the detailed examination of difficult problems, while any additional pressure such as is caused by the occurrence of famine, plague, or agrarian disturbance strains the groaning machine almost to breaking-point. My conviction is that in the interests both of the governor and the governed it is most desirable that substantial relief should be afforded to the Government of Bengal, provided that the price to be paid, whether in money, in popular discontent, or real injury, whether moral or material, is not too high.

Granting, then, that some relief was an urgent administrative necessity, the question next arises, has that relief been given in the best possible, or at any rate in the least objectionable, manner? Several schemes for securing the desired end were considered by the Government of India. One alternative suggestion which has been put forward by more than one of the Indian objectors, and by some Europeans, was to give Bengal an Executive Council such as is to be found in Madras and Bombay; but this suggestion has been rejected by the Government of India, and, in my judgment, with perfect correctness. The disadvantages of such a scheme have been found to outweigh its advantages; if it implies the appointment of a Governor from England, or from some other province of India, all the evils which at present attach to the appointment of a stranger would be perpetuated; if the Lieutenant-Governor were to be a member of the Bengal branch of the Indian Civil Service he would find it in many cases most difficult to be *primus inter pares*, and to carry on the administration with colleagues who might often be his disappointed rivals for the Lieutenant-Governorship. In any case the rule of such a council would be the rule of a committee, a form of administration which experience in India has shown to be almost universally inferior in efficiency to that of the individual. In case of dissension, if both councillors sided against the Lieutenant-Governor the result would be paralysis, while if one sided with him there would be a tendency for the other to be extinguished. From such disadvantages a personal administration is wholly free, while, at the same time, the head of the province is able unofficially to obtain, whenever he requires it, the advice and assistance which, in the other alternative, he would be compelled to solicit in all cases, whether he required it or not.

Another scheme which has been considered was the separation of Behar from Bengal, and its amalgamation with certain portions of the United Provinces into a new Chief Commissionership. Similarly, it has been proposed that Orissa should be converted into an independent administration by adding

to it portions taken from the Central Provinces and Madras. Both these schemes, however, are open to the cardinal and fundamental objection that they would increase the number of small provinces, which it is clearly the best and most statesmanlike policy to reduce. Such provinces are relatively expensive, they have no separate service of their own, and have to be officered by unwilling recruits lent by the larger provinces, and their financial, legislative, and judicial arrangements are troublesome and complicated. In fact, it must be conceded, I think, by every one who studies the subject dispassionately that the Government of India have adopted the right policy in deciding to create a new and fully-equipped province rather than to retain Assam as a Chief Commissionership, and form at the same time another new administration of a similar character, whether on the West or the South of Bengal.

Nevertheless, as I have said already, the proposals of the Government of India were met by strenuous opposition in Bengal. We have now to consider what were the grounds of this opposition, by whom it was supported, and what is the value of the objections which have been advanced.

The general grounds on which the opposition in Bengal has been based were stated, comprehensively though vaguely, in an address which was presented to the Viceroy at Mymensingh in February, 1904, and which alleged that the measure proposed by the Government of India "would subject the people of these districts to manifold evils and disadvantages in matters social, religious, educational, linguistic, legislative, and political, and in those connected with the administration of justice, and would deprive them of rights, associations, and privileges which they cherish most dearly." Somewhat similar language is used in the resolutions passed at the great meeting in Calcutta on the 18th March, which was held after the Viceroy had delivered his speeches in Eastern Bengal, and which resolutions formed the basis of a memorial which was submitted to the Government of India on the 5th October following. The resolutions are as follows :—

1. That this meeting desires to record its respectful but firm protest against the proposals of Government for the partition of Bengal on the following among other grounds :—

(*a*) That these proposals are viewed with grave and widespread alarm by the people of this province, and have given rise to an agitation unparalleled in its history. An opposition so strong and so universal should not be ignored.

(*b*) That the division of the Bengalee nation into separate units and the disruption of its historical, social, and linguistic ties would seriously interfere with the intellectual, social, and material progress of the people which it has always been a part of the traditional policy of the British Government in India to foster and to stimulate.

(*c*) That the districts proposed to be separated from Bengal proper would lose several constitutional, educational, and other privileges which they have so long enjoyed.

2. That this meeting is of opinion that the wider scheme of partition referred to by His Excellency the Viceroy does not commend itself to public opinion, and is viewed by the people of this province with great concern and anxiety, for the reason among others that its cost, initial and permanent, would seriously add to the heavy burdens already imposed on the people. Instead of allaying the anxiety and alarm which Mr. Risley's proposals had caused, it has intensified them.

3. That this meeting is of opinion that no case has been made out for the proposed measure, but that if in the opinion of the Government of India the relief of the Bengal Government is necessary, the remedy lies not in a re-distribution of territorial jurisdiction, but in organic changes in the form of Government, such as the conversion of the Lieutenant-Governorship of Bengal into a Governorship with an Executive Council like that of Bombay and Madras, and this meeting prays that the Government may be pleased to withdraw the proposed measure, or adopt the remedy above suggested.

When the Viceroy delivered his three important speeches in Eastern Bengal he dealt with all the arguments which had then been advanced against the separation of that part of the province. It is true that those speeches were delivered in February, 1904, and that the long memorial of the zamindars of Bengal, which was based upon the Town-hall meeting of March 18th, 1904, was not drawn up till October of the same year, but I think I am safe in saying that no new arguments were adduced therein, and that in the agitation which has since been revived none have been put forward which have not already been answered either directly or by necessary implication.

Speaking broadly, the objections raised to the reconstitution of Bengal were of two kinds, viz., first, those which were based upon pure misconceptions and misunderstandings, and, secondly, those which, though not baseless, arose chiefly from sentiment and personal feeling. To the first class belongs a long series of apprehensions which may be dealt with in

a few words. It was alleged that Eastern Bengal was to be ceded to Assam and enslaved by it; that the elaborate and highly organised administration of an ancient province which had been under British rule for 150 years was to give way to the more summary methods of Government which have been found suitable for the more backward districts of Assam; that Assamese and not Bengali would be the language of the new province; that the laws hitherto in force in Eastern Bengal would be superseded by the regulations in force in Assam; that the jurisdiction of the Calcutta High Court would be withdrawn; that the Board of Revenue, the chief revenue authority in Bengal, would cease to control the revenue administration of the transferred area, and that no similar authority would be substituted in its place; that the Eastern districts would lose the right of representation in the Legislative Council of the Lieutenant-Governor; that the educational advantages hitherto enjoyed by them would be withdrawn; that the Bengali language and the growth of Bengali literature were doomed; that ethnical and linguistic affinities were to be ruptured; that the Bengali nation was to be malevolently torn asunder; and that the social and domestic ties which had hitherto bound Eastern Bengal to the rest of the province were to be violently and irrevocably broken. Lastly, it was asserted in the memorial of October, 1904, that the formation of a new province would double the cost of administration, and that one of two alternatives must necessarily follow in both provinces: either they would be heavily taxed, or the administration would be starved, and many necessary and useful measures postponed or abandoned for want of funds.

To such of these objections as dealt with concrete allegations an immediate reply was forthcoming. It was explained that the districts of Bengal, which it was then proposed to transfer, with a population of $11\frac{1}{2}$ millions, could not possibly be swallowed up and absorbed by a province which contained only $6\frac{1}{4}$ million inhabitants, of whom 3 million were already Bengalis, and only $1\frac{1}{2}$ million were Assamese; that, similarly, it was unreasonable to suppose that Bengali would cease to be the language of the province merely because there was a change in the head-quarters of the administration; that not a single law or order which had been in force in Eastern Bengal would be affected, and that no outlandish laws would come into force there as a consequence of any reconstitution; that there was no intention to interfere with the jurisdiction of the Calcutta High Court; that if the control of the Board of Revenue were removed, another superior revenue authority would be formed to take its place; that the new province would be represented in the Legislative Council of the Governor-General, if indeed it did not receive a legislative council of its own, and that the educational advantages, hitherto enjoyed, would certainly suffer no diminution. Lastly, to deal with the financial question, the answer is that the change in the administration of Eastern Bengal will not cost either the old province or the new one penny in additional taxation or lead to decreased expenditure, inasmuch as the cost of the extensive building operations which will undoubtedly be required will be met by a grant from Imperial funds, and that the extra charges of the general administration will be provided for by an adjustment of the financial relations of the new province with the Government of India.

There remain for consideration the objections which are based upon sentiment and upon personal feelings. Of all countries in the world, except perhaps China, rural India is probably the most conservative, and the very idea of change is naturally repugnant to a people who have become attached by long habit and prescription to the maintenance of the *status quo*. Besides this, any proposal to distribute under two administrations a people who speak the same language, especially when it involved the separation of the greater part of them from Calcutta, was sure to give rise to a thousand petty apprehensions and misgivings, which do not readily occur to the Western mind but which do nevertheless exist.

The fear has been expressed that the dispersion of the Bengali-speaking people under two administrations will destroy the national feeling of unity which has of late years been sedulously developed among the educated classes. The answer to this is, that if national sentiment is animated by any real vitality of its own, the mere adjustment of territorial boundaries ought to present no obstacle to its development. An illustration of this argument readily occurs to the mind. The Marathi-speaking people are spread over at least two Administrations, and yet they retain a distinct and real unity of thought, language and political life.

The view taken by the Government of India of the agitation in Bengal was that it was

entirely machine-made and unreal, and that it was created in Calcutta, and organised and fostered from there. It is true that the great majority of those who have taken part in the demonstrations against the partition of Bengal know nothing of the matter except what they have been told by the organisers of the movement. It is also true no doubt that the leaders of the movement were mostly resident in Calcutta, being either landowners in the Eastern districts who have house property in the metropolis, and also their bankers, agents and lawyers in the same place, or else Calcutta men pure and simple, editors of newspapers, lawyers, merchants and others; all of these would lose a good deal of business and would be put to some inconvenience and loss if a large portion of the province were forced to treat some other place as the capital and the seat of the administration. Moreover it is to be remembered that to the educated Bengali Calcutta is what Paris is to the Frenchman. Not only does Calcutta resent having the districts which enrich and fertilise it intellectually, and go to increase its influence politically, torn away from it; still more do the districts resent being divorced from the centre to which they look for all that goes to make up civilisation for them. If Calcutta is the centre of political agitation for them it is also the focus of their educational, literary, linguistic, and commercial life. It is the centre to which in legal and business matters they have powerful and material attachments as well as sentimental ones, and though it may be truly said that in some respects those attachments need not be wholly severed, yet the change will be resented. The expression of discontent is doubtless machine-made, but the discontent itself is real and inevitable.

There undoubtedly is also a considerable class consisting of all the petty Government officials throughout Bengal, and men of similar social position, to whom the reconstitution will cause real inconvenience, and whose troubles, though each may be small in itself, will amount in the aggregate to a considerable sum of discontent. It is expected that the separation of Bengal into two parts will affect them in this way. The marriage question in Bengal is one of constant difficulty, and in this class as in others it is the aim of every father to marry his son or daughter to the best advantage—that is to say, not only in such a manner as to obtain an immediate competence, but so as to secure eventually influential relations and possibilities of advancement. It is obvious that, when official advancement will in future run in two separate streams instead of one, not only will the field for negotiation and arrangement be greatly narrowed, but in thousands of cases alliances and affinities which have already been carefully formed with an eye to future advantage will become infructuous and futile. This is one example of the way in which the separation of Bengal may affect a considerable section of the population; and, though these considerations may seem small in European eyes, yet I am satisfied that they are matters of great moment to thousands of our humble fellow-subjects in Bengal. It cannot be pretended for a moment that such objections as these are serious enough to affect the decision of a great administrative question, but they seem to deserve rather more sympathetic treatment than they have received. That they did not receive much sympathy is doubtless due to the belief of the Government of India that the whole opposition was fictitious and artificial.

A word may fitly be said in this place about the "Swadeshi" movement which has been mentioned from time to time in the telegraphic columns of our daily papers. As many in this room are aware, the word "Swadesh" means "own country," and the Swadeshi movement is, therefore, "the patriotic movement." The form which it has taken is the boycotting of European goods, and the determination, as far as may be possible, to use none but home products as a protest against the action of the Government in dismembering Bengal, and as a means of welding together national feeling on the subject. This movement was inaugurated, if I remember right, about the time of the Lakshmi Pujah in Bengal, a season when it is the universal custom to exchange presents, to an even greater extent than Europeans do at Christmas. These presents consist largely of articles of dress, and many thousand yards of cotton cloth and silk are sold at this festival. This year the boycott affected the sale of these articles very seriously, and though a comparatively small number of shops selling native goods made a handsome profit, a much larger number of shops, both wholesale and retail, lost heavily. A further development of the Swadeshi movement led to the picketing of obnoxious shops and the molestation of purchasers; these incidents, however, brought the actors in them within the grasp of the law,

and I believe that this form of interference is no longer exercised.

I have been frequently asked whether there is any vitality in the Swadeshi movement, and whether any importance should be attached to it; and my answer has always been in the negative, for two reasons. In the first place, if a boycott of this kind is to be maintained to such an extent as to be effective, it presupposes a far-reaching and effective organisation for the purpose; but the Bengalis, with much cleverness and ability, have not so far displayed much capacity for large business operations of this kind: they have neither the power of combination nor the capital. Secondly, the movement involves a considerable degree of self-denial and self-sacrifice, since the natural products of the country are often inferior to the imported article, and also more expensive: patriotism which exists and flourishes in opposition to pecuniary self-interest is patriotism of a high order, and it has not yet been attained by a sufficient number of the people of Bengal to make the movement dangerous.

Finally, let me sum up rapidly the advantages and disadvantages which may be expected to accrue to the old and the new province respectively from the reconstitution which has just been carried out. In Bengal the main advantage must be that which has from the first been the aim of the Government of India, *i.e.*, the relief to the Government, which will now be freed from the burden of nearly one-third of its former population; indirect advantages, the result of that relief, may be expected in the more detailed attention which the Lieutenant-Governor will be able to give to all branches of the administration in the smaller province to be left under his charge. Bengal will still retain the most populous part of the old province in Central Bengal, the opium and indigo districts of Behar, the tea of Darjeeling, the mineral wealth of Chutia Nagpur. Most important of all, its capital will still be the great city of Calcutta, the winter capital of the Imperial Government, the second city in the British Empire, and one of the twelve largest cities in the world. Its population, including its suburbs, which are as much a part of it as Southwark and Lambeth are of London, was at the last census 1,106,738, and the questions connected with its administration are of ever-increasing difficulty, interest, and importance. The disadvantages will be mainly social and sentimental rather than material, but undoubtedly Calcutta will suffer somewhat from the withdrawal of part of its trade, and a certain number of the educated classes in Calcutta will be pecuniary losers.

To the new province, and especially to Assam, the reconstruction should bring nothing but advantage. The administration, with the plentiful funds which it is sure to receive at the outset, will be brought to a high state of perfection in accordance with the lessons learned in other parts of the Empire. In particular it will now have a service of its own, a reform which of itself must effect a great improvement in the government of the country. Two other special features in its development must be the rise of Dacca and of Chittagong. The former city has a great history and a splendid past; during the greater part of the seventeenth century it was the Mohammedan capital of Bengal, and a hundred years later, in 1800, it contained 200,000 inhabitants; at the census of 1901, the population was returned as 90,000 only, but there is no reason why, under the new conditions, it should not regain its former greatness. Chittagong offers a safe harbour on a navigable river which is free from the dangers and difficulties which beset the passage of the Hooghly. Owing to its distance from Calcutta, to the want of funds and to the absence, until a few years ago, of railway communication between the port and the interior, Chittagong has been for years the Cinderella of Bengal; for instance, in 1903-4, the value of the foreign seaborne trade of Bengal was $103\frac{1}{2}$ crores of rupees, of which Chittagong claimed only 2·3 per cent. But the place has great possibilities, and with the development of the port, which will cost a comparatively small sum, this must all be changed; it must soon attract a large share of the rice and jute of Eastern Bengal, the tea of Northern Bengal and Assam, and the coal of the latter province, and there are many who think that before many years are past Chittagong will become the Karachi of Eastern India. Another result of the reconstitution of the two provinces will be that while Bengal will be mainly a Hindu province, the new province will be a Mohammedan province to a large extent, and to the Mohammedans the rise of Dacca should be a stimulus and an inspiration. They have long complained that they have been distanced in the race of life by the clever and more adaptable Hindu, and it will be a matter of great interest to observe how they will fare in a pro-

vince where they will be the predominant class.

What then is the conclusion of the whole matter? Speaking as a Bengal civilian I regret as a matter of sentiment, which is shared by many others both European and Indian, the dismemberment of the greatest and richest province in the Indian Empire, and the dispersion of its Civil Service, which looks back upon the splendid traditions of 150 years. I am inclined to question the necessity of transferring the Rajshahi Division in addition to those of Dacca and Chittagong and thus giving up two-thirds of the Bengali-speaking population of the province, and I regret that Maldah, the seat of the Mohammedan kingdom for three centuries and a-half, should pass out of the control of the Lieutenant - Governor of Bengal. I think that the grievances of those who opposed the reconstitution of the province might have been dealt with in a rather more sympathetic spirit. Lastly, it is to be regretted on some grounds that the public were not informed of the later developments, although such action was not actually incumbent on the Government of India. These, however, are details; sooner or later, a reconstitution of the province must have been carried out, and I believe that on the whole the measures which have now been adopted will effect their object well and satisfactorily, and so thoroughly that the operation will not need to be repeated. I hope that in Bengal the scars of the amputation will be healed ere long, and that the body politic will be the better for the operation. For the new province the reconstitution should bring nothing but benefit, and as soon as the dust of conflict has settled down, and time has softened the resentment and discontent still felt in some quarters, I confidently believe that she will enter upon an era of assured progress, prosperity, and contentment.

DISCUSSION.

The CHAIRMAN thought the Society was very much indebted to Sir James Bourdillon for the admirable paper he had read. In its arrangement, lucidity of expression and mastery of the various subjects with which it dealt, he had seldom heard a better paper. Sir James had throughout shown a complete impartiality, and had summed up accurately the advantages and disadvantages which the proposed change entailed. As he had long been familiar with the subject, he would like to say a few words in opening the discussion. So far as he could recollect, with scarcely an exception he had never come in contact with a Lieutenant-Governor of Bengal who, if not pressed, had not at once admitted that the work he had to perform was an almost undue strain upon his strength. They had not merely to deal with the fact that one distinguished officer was overworked, his health thereby suffering, but the secretariat was also overworked, the consequence being that time after time the Government had had their attention called to the fact that a certain portion of the administrative machinery of India was unequal to bear the strain which was constantly imposed upon it. It was not a question of individuals. If those at the head of affairs were so taxed the interests of those whom they administratively governed suffered. He was first connected with the India Office thirty-two years ago. At the time, 1873-1874, there was a great alarm, not only in this country but in India, that there would be a great famine in Northern Bengal. Six years previously there had been a famine in Orissa, a great loss of life occurring; and although it was to a considerable extent due to the want of proper communications with Orissa, it was also, he thought, attributable to the overworked condition in which the Lieutenant-Governor of Bengal was at the time. The public was so much interested in regard to the prospect of a famine in Bengal that it insisted upon preparations being made which were in excess of what was required. His experience, therefore, of the result of the overworking and the strain imposed upon the Government of Bengal was that in 1886 there was a famine in which there was unnecessary loss of life, and in 1873-1874 there was an unnecessary expenditure of money to avert a famine which never attained the dimensions which were anticipated. When a Government constantly had its attention called to such defects in its machinery it was bound to remedy them; and if any change was made it was their duty to see that the change was a complete and thorough one, because a small change caused almost as much dislocation as a large one. He, therefore, thought the Government were perfectly right, if they dealt with the question at all, to take it up in the broad spirit in which they did. He thought the word "partition" was a misleading word. When people talked of political or administrative partitions, it brought into one's mind the idea of something like the partition of Poland, which was a forcible dismemberment of a nation, portions being handed over to three different Governments that had nothing in common. That was a partition which deprived people of privileges to which for centuries they had been accustomed. What had really happened in Bengal was not a partition; it was a duplication of machinery, which had been proved to be efficient. It had given to Bengal two Lieutenant-Governors, two Secretariats, and two Legislative Councils. And surely if the work of one Lieutenant-Governor, one Secretariat,

and one Legislative Council had been satisfactory, would not the work of another Lieutenant-Governor, another Secretariat, and another Legislative Council, moulded on exactly the same lines, be also satisfactory? With regard to the question of famine, as the author had pointed out, a famine in Eastern Bengal had never been known, but Northern Bengal was periodically subject to droughts, and to possible prospects of famine. Not the least important of the work of the Government was to keep its famine code up to date. That was not necessary in Eastern Bengal. If a famine year broke out in Western Bengal, the attention of the whole Government of Bengal was necessarily distracted from their ordinary business in order to deal with the exceptional difficulty to which Western Bengal was subject, and during that period the interests of Eastern Bengal must necessarily suffer under the present system. As had been pointed out, the climate of the two parts of the province was different. Eastern Bengal had the most magnificent series of natural waterways of any country in the world, and had a very fine harbour at Chittagong. One of the disadvantages of the present system, in his judgment, was that Calcutta got far more than its fair share of what he called Imperial expenditure. Calcutta was the headquarters of the Central Imperial Government, and there was necessarily a very large outlay of money distributed in Calcutta in connection with the Government offices. But Calcutta was also the centre of the great Government of Bengal. Undoubtedly the duplication of Government and the establishment of a Lieutenant-Governor, with offices at Dacca, would for the future secure to Eastern Bengal a certain proportion of the money which hitherto had been entirely spent in Calcutta. Chittagong was a rival port to Calcutta. As long as the Government of Bengal was entirely located in Calcutta, Chittagong, and ports which were rivals to Calcutta, would not get as fair treatment as they would do when they were under a Lieutenant-Governor who was in no way connected with Calcutta. Personally, he believed there would be an immense increase in the export trade of Eastern Bengal if the system of communications and harbours was improved; and if it were, from a material point of view, to the benefit of Eastern Bengal that the present system of government should be duplicated, it was hardly fair for Western Bengal to decline to grant to another part of the province the advantages which she had so long possessed herself. The author seemed to think that one of the grounds of Lieutenant-Governors in the past being overworked was that certain of them had accepted the post of Lieutenant-Governor who were not members of the Bengal Civil Service. He had always noticed that when a member of the Bengal Civil Service was made a Lieutenant - Governor of another province, the appointment was received by the Bengal Civil Service with great acclamation, but he did not know that the feeling was quite reciprocated when the tables were turned. All who were accustomed to Indian administration would however, he thought, admit that the occasional bringing in of an able man from another province, although he was not a member of the Civil Service of the province which he was to govern, benefited the system of administration of which he was placed in control; and although he thought the rule should be that the office of Lieutenant-Governor should almost exclusively be reserved to the Civil Service of the province which he governed, he should be very sorry to lay down a hard and fast rule that no outsider should ever be appointed. He also agreed with the author that the idea of appointing a Governor with two Councillors was one that must be immediately dismissed. The practice now prevailed in Madras and Bombay, but it was a relic of the past, and he did not think anybody who was acquainted with the working of the system of Madras and Bombay would propose to establish it *de novo*, and apply it to any other part of India. Sentiment and emotion were great motive forces to which attention should always be paid, but they ought not to be dictated to by them. Those forces must be harnessed to common sense and to a knowledge of the facts which had to be dealt with. It seemed to him that the language which had been directed against the proposal under discussion had been absurdly extravagant. He quite understood the discomfort and inconvenience which must be caused to the lawyers, merchants, bankers, landowners, and gentry, who might hereafter have to live a certain portion of the year at Dacca, instead of at Calcutta; but, after all, those whose interests were thus inconvenienced could be numbered at the outside by hundreds; and surely if a change of the kind suggested was going to benefit many millions, they ought not to allow the temporary inconvenience of a few hundreds to arrest or impede the great reform. It might be that the Government of India did not as fully publish their intentions and details as might now seem to have been advisable; but looking to the nature of the opposition with which their proposals had been received, and the class of agitation which was being raised against it, he was not sure they were not right in keeping back until the last moment the proposals they intended to make, and he was not certain that if they had adopted the course suggested they would not have been subject to perhaps more violent criticism than they had been. If there were any gentlemen present who believed that by the duplication of administration in Bengal they would lose any of their rights and privileges, or that the homogeneity of the Bengal race was in any way prejudically affected by the change, he would console them by reminding them of what had occurred in this country. England was divided into counties, the most clannish of which undoubtedly was Yorkshire. Yorkshire was the largest county, so large that some time back the work of locally administering it became too much for one Lord Lieutenant; so it was divided into three,

and there were now three Lord Lieutenants and three separate systems of local government. Did any Yorkshireman pretend that the homogeneity of the Yorkshire race had been in the smallest degree affected because there were three Lord Lieutenants instead of one? On the contrary, they admitted that in consequence of the change, whilst the homogeneity and the good opinion that the Yorkshire people entertained of each other was still unaffected and undiminished, their system of administration had been improved. He sincerely hoped that even those who thought their interests were prejudicially affected would be disposed to look in a more reasonable light at the changes that had been made. He predicted with the utmost confidence that, in less than ten years, so beneficial would be the result of the change that the only remark which would be made about it would be "Why was not it done before?"; and he was pretty confident that not the least warm of the admirers of the new system, so soon as it came into operation and its full benefits were appreciated, would be those who had recently been loudest in its denunciation.

Mr. S. M. MITRA said that after the learned paper of Sir James Bourdillon he had very little to say. The Bengali was not a farthing the worse in body, mind, reputation or pocket, for the so-called partition. There were about 10,000 Bengalis settled in Allahabad and Lucknow, and a similar number in the Punjab. They were not only under different Lieutenant-Governors and separate High Courts, but actually under two different universities. He asked whether the so-called national tie of the Bengali had been broken in any way. The Bengali boy of the Punjab spoke Bengali; the Bengali girl of Lucknow sang Bengali songs, and they married in Bengal whenever they liked. Thanks to the sense of justice of the British Government, the Bengali, whether in or out of Bengal, got on all the same and famously. To-day Mr. Justice Banerji, a Bengali gentleman, dispensed justice in the Allahabad High Court, and Mr. Justice Chatterji, another Bengali gentleman, adorned the bench of the Punjab Chief Court. Mr. Tagore, the eminent Bengali, who had been in the Bombay Civil Service for over a quarter of a century, was in no way denationalised. On the other hand, he was the author of Bengali works, and now, since his retirement from the Indian Civil Service, was a leader of Bengali thought at Calcutta, and the ladies of his family were the leaders of the Bengali society of Calcutta. So, the Bengali, whether he lived among the Persianised polished inhabitants of the United Provinces, or among the warlike Mohammedans and Sikhs of the Punjab, or amidst the typical Aryan culture of Poona, was everywhere a Bengali, and everywhere successful. His success was due to his intellect and the sense of justice of the British Government. Under no other Government would he ever have had such chances. The incoherence of various races which formed the population of Bengal prevented unity. Since the Mohammedan conquest, Bengal had been considerably disturbed by exotic influences. The stability of the Bengali now depended not upon exclusiveness but upon assimilation. Real nationality was often created by the stress of inter-racial conflict for progress. A sympathetic Government which helped in surmounting tribal and racial antipathies was more effective as a bond of nationality than territorial unification. Language, religion and intermarriage were the bonds that united social groups and preserved social continuity, and no bond of union was more elastic and less likely to snap than those. Those bonds did not exist between even the Hindu of Calcutta and the Hindu of Cuttack. Where those bonds had existed no administrative border line had injuriously affected them, as had been seen in the case of the Bengali in the United Provinces and the Punjab. Why should then the border line of the so-called partition destroy the unity between the Bengalis of Calcutta and the Bengalis of Dacca? Bengal, as the largest province of India, had entered the comity of nations, simply by being taken in tow by England. The increase in the population and the prosperity of the Bengali, had produced an upward pressure upon the administrative structure and necessitated an alteration to adjust the stability of the edifice. The partition was a measure to remove disabilities of the Bengal millions. Bengal would soon readjust her equilibrium and harmony would be established. When once an intelligent people had got shaped into political existence it soon adapted itself to its surroundings, and, notwithstanding so much talk, in India, fraternity was as distant as ever. The average uninformed Englishmen evidently had been led to believe that Bengal recently underwent a succession of political earthquakes. Telegrams from India referred to terrible convulsions which had a dangerous resemblance to revolutionary jargon. But had the country anything to do with the so-called agitators? No, it was only the ventriloquism of demagogic experts. In his memorable speech at Dacca, in February, 1904, Lord Curzon had fully exposed the tactics of the professional agitators of Calcutta. Mr. Mitra thought it was saddening to see some of the officials of the Anglo-Indian bureaucracy slash away in good democratic style at their own Government. They did not pause to consider the amount of mischief that thoughtless talk caused. Every step of the Indian Government, forward or backward, as it appeared in varying forms, as viewed through different intellectual media, they used for party purposes. Such tactics might produce for a moment startling effects in their own political circles, but they were dangerous for the cause of India, and when handled in parliamentary warfare, fatal to Imperial interests. Their patriotic budget was never complete unless it dealt with attacks on the eternally besieged citadel of the Government of India, while those who directed from London the destinies of 300 millions, placed by Providence in their charge,

evidently looked upon such tactics with philosophic indifference, seldom trying to counteract the baneful effects of a mischievous propaganda, which libelled practically every act of the Government of India. He hoped that the Home authorities, who possessed the power to influence Imperial consolidation, would properly exercise that power. Indian agitators had told the British public that the agitation had penetrated to the masses. But, according to the last Indian Census, not more than 15 millions, or 5 per cent. of the population of India, knew how to read and write even their mother-tongue! How did they even hear of the partition? According to the report of the Indian Post Offices for last year, on an average each inhabitant of India wrote only two letters per year! That would give an idea of the interest the Indian masses took in political speeches and the question of the partition of Bengal. He visited Malda in April last, and it was then officially notified that Malda was to go to the new province. He was a week in Malda. The masses had actually no idea of the intending separation. They looked upon the Collector as a guardian; it was a matter of little consequence to them whether the Collector communicated with Calcutta or with Dacca. In conclusion, he said that to say that the British were breaking the linguistic tie of the Bengali was to distort facts. The modern Bengali language was the creation of the English. In Warren Hastings's time there was no dictionary or grammar in the Bengali language. The first Bengali grammar, as well as the first Bengali dictionary, was written by Englishmen for them! Carey and Marshman did for the Bengali language what Wycliffe had done for the English, and Luther for the German. Each and every Bengali author who had enriched the Bengali language had himself been the product of English education. There was as much difference between the pre-British Bengali as there was between the language of Thucydides and modern Greek. In short, the modern Bengali language, as Sir George Birdwood recently pointed out in the columns of *The Times*, was emphatically a British creation. No administrative measure like the partition would have any injurious effect on the growth of the Bengali language and literature. Burns and Scott were no less English authors because Scotland is in a way separated from England. It was perhaps the separation that brought about the intellectual eminence of Edinburgh. Administrative border lines had not in any way interfered with the growth of the Hindustani language. The partition of Bengal was in every way an admirable measure, calculated to do good to the millions.

Mr. H. BEVERIDGE said that, as an old Eastern Bengal officer, he had never liked the suggested partition of Bengal, and from what he had heard of the paper it seemed to him that the author spoke much more strongly against the partition than in favour of it. Mr. Gladstone had said that no one could imagine the strong fibres that would have to be cut in order to disestablish the Church of England, and the same remark applied to the question under discussion. He was by no means touched by the argument with regard to the population, because if the argument was pushed to its legitimate conclusion there ought to be no Governor-General, on the ground that the office he held was too onerous for any man to fill. A good deal had been heard about the improvement in administration which would be effected by the change, and also a great deal had been said about scientific frontiers. Scientific frontiers had nearly been the ruin of India. Supposing, for instance, the Scotch people said that it was a great mistake that Berwick-on-Tweed should belong to England; it was on the north side of the Tweed, it used to belong to Scotland, and that it would be in many ways exceedingly convenient to annex it to Scotland: what would English people say to such a proposal? Although he thoroughly disliked the partition of Bengal, he supposed it was very little use kicking against the pricks, and the proposal would probably have to be accepted. It was suggested that Dacca would be the new capital, but he very much feared it would be found in course of time that the expense of erecting public buildings there, and also the notorious unhealthiness of the place, would prevent the scheme from being carried out, and the seat of Government would be transferred to Shillong. He felt perfectly sure that either some high official at Dacca or his wife would die, or some old story of a Commissioner having died there would spring up, so that he very much doubted whether, after all, Dacca would be made the capital of the new province.

Sir CHARLES ELLIOTT, K.C.S.I., stated that he would like to mention his own experience as a former Lieutenant-Governor of Bengal—an experience which the reader of the paper had rather discounted by saying that he came to Bengal as a stranger. It was perfectly true that that discount must be allowed; but, on the other hand, he wished to say that he had occupied many high and difficult positions in India, and in every one of them he was able, on the whole, week in and week out, to say, when he laid down at night, he had fairly grappled with the work and done his duty; but he did not think there was a single night during the time he was Lieutenant-Governor of Bengal that he ever had that solace when closing his eyes. He always felt the work was beyond his power to cope with properly, and that he was leaving not a little undone, but half of it undone. He never came to the end of the occupancy of any post in India with so much satisfaction as when he left that high and honourable position, to which he felt he was not doing justice. With regard to the question of the partition, he thought they owed the Chairman thanks for the excellent phrase he had used in calling it, not partition, but a duplication of administrative machinery. In every case of a similar

rectification of frontier that had occurred in India during the last fifty years, exactly the same discontent and dislike had been experienced at first. In his very early days he remembered the transfer of Delhi to the Punjab. It was a particularly bitter blow to the inhabitants of that proud old Mohammedan town, which had been conquered largely by the help of the Sikhs, that it should be taken away from the North-West and given over to the Punjab. Discontent was rife at the time, but in ten years he did not think anyone could have heard a single voice which regretted the transfer or even remembered it. The people found it made no difference to them, and that they were as well governed under the Punjab as they had been under the North-West. Then there was the transfer of the Sangar and Nerbudda territories to the Central Provinces, which was a good deal disliked at first. The old objections held good which the reader of the paper had mentioned, the connections of business men and lawyers had to be torn apart, but everything very soon settled down. Comparatively recently Oudh had been transferred to the North-West, to the very great discontent of the people. It had often surprised him to think why the Tara class did not give more trouble over it, because they were extremely important and weighty persons, highly respected by the Government both in India and in England. They protested and memorialised, but they had not learned the art of getting up public meetings and had not the control of newspapers; and their indignation and distress, which were sincere and genuine enough at the time, found no very clear outlet and soon passed away, and he was quite certain that at the present moment there was not a single Talukdar who looked back with regret to the time when he had a separate Chief Commissioner of his own. The people were quite content to be amalgamated with the United Provinces. Just the same kind of thing was seen in England. The Chairman had mentioned the division of Yorkshire into three Ridings. Within a few miles of the Society of Arts the same kind of disruption had been going on, to the very great discontent of a number of worthy people. When the bishopric of Southwark was created, a rectification of frontier had to be made, and a number of parishes which had long been connected with the diocese of Canterbury were transferred to Southwark, and (he believed) in one case to Rochester. They greatly disliked it, very much for the sentimental reason of being connected with a magnificent old cathedral, under the highest prelate of the Church, and with the historic and artistic associations which surrounded the name of Canterbury. They felt the change acutely, but they did not make any loud fuss about it; they had settled down, and he did not suppose by now it occupied much of their thoughts. He thoroughly agreed with the Chairman in his prophecy that in a very few years there would be no vestige of the dissatisfaction in Bengal which now seemed rather serious and portentous. There was one more thing to be said on the question, which had not been referred to, namely, that if there was anybody who would suffer, it would not be the Bengalis, but the Assamese. When he was Chief Commissioner of Assam it was the fixed doctrine with the officials that Assam should be kept for the Assamese. The more educated and more pushing Bengalis were getting positions in the offices, and so forth, and the desire of the Government was to keep them out as far as possible. That had all gone now. The Bengalis would come in like a flood, and get all the appointments, which he tried to keep them out of when he was guardian of the interests of Assam. He had often wondered since whether the supposed injury was a real one, and whether in the long run the Bengali competition was not better for the Assamese than to keep them out and confine the posts to men who were of inferior ability and education. As far as he could see, no possible injury would accrue to the Bengalis by the duplication of authority, and he was convinced that in a very short time all the present sentiment and irritation would have passed away.

Sir GEORGE BIRDWOOD, on behalf of the audience, expressed the pleasure with which they saw Lord George Hamilton again in the Chair at a meeting of the Society of Arts, especially those of them who had been so long connected with His Lordship in the India Office. His impartiality in the chair, and the manner in which he had, in the course of his speech, illuminated the question under discussion, were gratefully appreciated by them all.

The CHAIRMAN, after thanking Sir George Birdwood for his kind expression of feeling, proposed a cordial vote of thanks to Sir James Bourdillon for the admirable paper he had read, which had practically convinced everybody that what he had written was correct.

The resolution of thanks having been carried unanimously,

Sir JAMES BOURDILLON, after thanking the members for the kind manner in which the vote of thanks had been accorded, said that when he heard that Lord George Hamilton was to take the chair at the meeting it gave him very great pleasure, and the pleasure had been intensified by the manner in which he had carried out his Chairman's duties, the additional information he had given in the course of his speech, and the judicial and impartial tone in which those remarks were conceived and delivered.

MR. H. LUTTMAN-JOHNSON writes:—I have been asked to make a few remarks because I spent nearly the whole of my service in Assam and Eastern Bengal. I may say at once that I view the subject from below,

from the point of view of the people affected by the measure. This is not the view of "far-sighted statesmanship," of course. The people of Assam and Eastern Bengal are among the most prosperous on earth. They are so well off that they can afford to be ashamed to dig. Digging is almost all done by imported labour. Very few have to work for wages on the land. Famine is not known; a failure of crops may produce temporary scarcity locally. A friend in the City says the recent rise in the price of jute has put £12,000,000 sterling into these people's pockets. They are very lightly taxed, their soil is extraordinarily rich, and the damp climate suits not only jute but many other crops. The people of Assam Proper are largely clad in silk and the people of Eastern Bengal generally in imported cotton cloth. These people have reached this extraordinary prosperity without much assistance from governors and boards, *ex hypothesi*, governors and boards at Calcutta have generally not had time to attend to them. I think it is quite clear that a new Government at Dacca will not in anyway hinder the wonderful natural progress which these people are making. The forces making for progress are so strong that no Government could control them. I am not sure that I quite agree with his Lordship that so much progress having been made under the Calcutta *régime*, we may expect much more under the Dacca *régime*, that is, that the more governors and boards of revenue we have the better for the people. I am content to reply to the opponents of the measure that at the worst the progress made in the last fifty years or so will continue. I am, of course, assuming that the people do not pay for the new Government and that new taxes are not imposed. In one direction the multiplication of governments is dangerous. His Lordship, when Secretary of State, often animadverted on the enormous amount of writing done by the Indian officials. Lord Curzon has endeavoured to curtail the writing. No local officer would ever write a word more than he could help. His work is too heavy and too engrossing to leave room for writing. All time spent in office writing is taken from the real work. On the other hand, the higher authorities, Government, boards, &c., have only writing to do. The more active they are the more they write. Unfortunately, the actual work in India is done, especially in the hot season and rains, under very trying circumstances, so that the temptation to put aside the work and to sit in an office writing is very great, and the writing often constitutes a sort of advertisement. So that the stronger the Government, boards, &c., are, the more the local officers have to write. The amount of stationery consumed in the Province of Assam is much greater now than it was when the province was started 30 years ago. God forbid that the new Province of Eastern Bengal should follow in the same course. Nothing has been said about the abolition of the Province of Assam. This province was started not on its own merits, but to relieve the Calcutta Government. It had no other *raison d'être* and has now been very properly abolished. Some allusion has been made to devolution. The Governor at Dacca would be obliged to delegate his authority, just as the Governor at Calcutta did, if he was a wise man. Some Governors have tried to do all the work themselves, that is unaided, and have necessarily failed. Whether a Governor has 100 millions or 10 millions to deal with makes no difference in this respect, one man unaided could not properly manage a district. I notice the present Governor at Calcutta is arranging such devolution; perhaps former Governors would have been well advised to have taken this simple course when they found the work too much for them. I notice, too, that the Governor at Calcutta is relieved of very few of the duties which, in his dispatch on partition, he enumerates as so onerous. The form of devolution adopted in Bombay, where the Commissioner of Scind has very extensive powers under the Government of Bombay, might perhaps have received greater consideration than has been given to it. A Chief Commissionership of Behar, Bhaghalpur, and Chutia Nagpur, under the Governor of Bengal, would have been a great relief. I do not think our Bengali and Assamese friends need be the least alarmed that their very great material prosperity will be in any way adversely affected by the partition and abolition. And I hope the claim of the new Governor at Dacca, that his rule will be for the moral advantage of the people will be fulfilled, but the order is doubtless a large one.

FIFTH ORDINARY MEETING.

Wednesday, December 13th, 1905; HIS EXCELLENCY THE JAPANESE AMBASSADOR in the chair.

The following candidates were proposed for election as members of the Society:—

Dickinson, J. H., Litt.D., F.R.S.L., 6, Claremont-terrace, Blackpool, Lancs.

Ericsson, Axel Fredrik, Mayfield, Jesmond, Newcastle-upon-Tyne.

Evans, Edw. A., The Quebec Railway, Light and Power Company, Quebec, Canada.

Johnston, George Lawson, 29, Portman-square, W.

Mawjee, Purshottam Vishram, J.P., M.R.A.S., Vishram Bhuwan, Warden-road, Bombay, India.

Oke, Alfred William, B.A., LL.M., F.G.S., F.L.S., 8, Cumberland-place, Southampton, and 32, Denmark-villas, Hove, Brighton.

Sale, Frederick G., 54, Old Broad-street, E.C.

Singh, H. H. Maharajah Sardar, Jodhpur, Rajputana, India.

The following candidates were balloted for and duly elected members of the Society:—

Barclay, Robert Leatham, M.A., 54, Lombard-street, E.C.
Hellyer, Robert Edgcombe, Farlington-house, Havant, Hants.
Jones, William Herbert, 8, Birch-grove, Rusholme, Manchester.
Nathan, Sidney Herbert, M.D., 50, Harrington-gardens, S.W.
Rhead, George Woolliscroft, Doune-lodge, Oxford-road, Putney, S.W.
Roese, Otto, 4, George-yard, Lombard-street, E.C.
Rogers, L.D., M.A., M.D., LL.D., National Medical University, Chicago, Illinois, U.S.A.

The paper read was—

THE COMMERCE AND INDUSTRIES OF JAPAN.

By W. F. Mitchell.

I feel some diffidence in bringing before you so vast a subject as industrial and commercial Japan, particularly in the presence of our distinguished Chairman, His Excellency Viscount Hayashi. My credentials are merely a 16 years' residence in that delightful country, during which time I have seen many changes, and had an opportunity to observe a rapid development in its trade and industries. I shall endeavour to give you an outline of some of the most interesting features of this trade, which has assumed such large proportions that it is impossible to deal with it in extenso.

After a hurried rush through some parts of the Empire, I have heard of visitors, thinking that they know more than the Japanese themselves, who go home and write a book, generally full of inaccuracies. For my own part, it seems to me that, after being in close business and social contact with the Japanese people over a series of years, I have still much to learn, as regards their spirit and innermost workings. A book which has recently been published in this country, but which came out some years ago in the United States, entitled "Bushido, or the Soul of Japan," by Dr. Nitobe, gave me an insight into Japanese character which I had hitherto only partially understood, and I should strongly recommend any of my hearers that have not read it to do so.

Bushido has been strongly exemplified in the recent war, and has brought to notice qualities in this people that have staggered Europe, and led Japan to a glorious victory over a foe which other nations considered by no means despicable. I may add that Japan's friends have been astonished, not so much with their victories, but rather with the wonderful organisation, self sacrifices, and unity of the people that have brought it about. I mention this incidentally, because the same weapons have been, and are, being used in a peaceful way for the expansion of Japan's trade which, I am sure you will agree, has advanced with phenomenal strides. Now that the combat with Russia is over, the country will devote itself with precisely the same energy to the development of trade in Japan, as well as in Manchuria and Korea. If the British Empire is to hold its own in the commercial centres of the East, it behoves us as a nation to take a lesson from Japan's preparedness for war, and to see that we equip ourselves with the latest and newest weapons of commerce, in order that we may not have to drop out when it becomes a question of the survival of the fittest. Personally I do not believe in the "Yellow Peril" bogy, but that we may encounter our allies on the commercial field of battle is more than probable.

The connection of this country with Japan is of very old standing. The first Englishman who resided there was Will Adams, who, attached to the Dutch East India Company as a pilot, landed near Nagasaki in the year 1600. He was brought a captive into the presence of Ieyasu, the then ruler of Japan, who took such a liking to him that he was retained at the Court, and acted as a kind of diplomatic agent when other European traders began to arrive, and it was mainly due to his influence that English traders obtained at the time a footing in the country. He died in 1620, and his grave was some years ago discovered by an English merchant residing in Yokohama, who raised a subscription amongst his nationals to put it in repair. Unfortunately, the trade connections between the two countries did not at that time become permanent, and for over two centuries Japan was closed to the outer world, when, owing to the insistence of the American Commodore Perry, the first foreign treaty was signed in March, 1854.

From that time onwards Japan has, from a European standpoint, advanced by leaps and bounds, and raised herself to the status of a first-class power, so much so that a treaty, which must have far-reaching consequences, has been concluded with this country, forming an alliance which will, I believe, be a lasting

credit to the statesmen of both countries. I take this opportunity of congratulating His Excellency Viscount Hayashi for the share that he has taken in the consummation of so valuable a link in binding the connecting ties, which I believe will not alone be in the interest of peace, but also in cementing the commercial relations of the two contracting powers. Japan has gathered her laurels with her army and navy, and will surely do so with her commerce, and, as my paper is to deal with that subject, I fear that I am digressing, and will, therefore, at once proceed.

Treaty Ports.

These were Yokohama, Kobe, Osaki, Nagasaki, and Niigata, opened to foreigners to trade from the years 1854 to 1869. Yokohama and Kobe grew with astonishing rapidity; the first-named, from a small fishing village, has become the busy trade centre shown on the screen. Ex-territoriality was, by Treaty, abolished in the year 1899, and foreigners are free to trade and travel without passports in any part of the country, a privilege that has only been partially availed of, as trade clings to its old channels. Foreigners were naturally averse to coming under Japanese jurisdiction, of which they were but imperfectly acquainted. Thanks to the Government, who have done everything in their power to make the transition stage as easy as possible, the change was less serious than it looked, and aliens now enjoy as full liberty and protection as they can, under the circumstances, expect. The ports opened to foreigners, where trade has been initiated and developed, were important factors in Japan's commercial growth, and I am sure that the Government recognise that the stranger within their gates has materially assisted in building up their commerce.

To trade you require merchants or dealers who are prepared to buy or sell, barter, or exchange. I have already referred to the closing of the country to foreign intercourse. From the year 1624 everything foreign was prohibited, with the exception of an apology for trade with the Dutch at Nagasaki. Consequently, Japanese merchants who had, up to that time, been a power in the land very soon ceased to exist, as their *raison d'être* had gone. This state of affairs lasted for over two centuries owing to the strong military spirit, tempered with the aristocratic bearing of the Daimios and their retainers and their contempt for a trader. The restrictions placed upon trade prevented any expansion, and the condition of the merchant became merely that of a shopkeeper. There were, of course, exceptions, and the existence of some few powerful firms, who were more or less directly associated with the governing powers, might be traced back for a long period, but it was not with such establishments that the foreigner came into contact when the country was again opened to foreign intercourse, but rather with a set of irresponsible adventurers, who sometimes gained for their country an unenviable notoriety, due to the lack of an intelligent merchant class of the standing which any trader may now acquire. A better class of merchants and, in many cases, wealthy firms, are taking the place of the old type. I hope the day is not far distant when the integrity of all merchants will be equal to that of the Government.

I do not say that Japan has a monopoly of dishonest traders, as they, unfortunately, exist in every country, but I refer to this point because one frequently hears that there is a lamentable lack of commercial morality in Japan. I do claim that the class of the average dealer (not really the merchants) which came into contact with foreigners left much to be desired, and that as a consequence their foreign *confrères* were looked upon by the better class Japanese as belonging to a similar category. All that is changing, and in many respects has changed. The Government and the official classes no longer despise trade, but recognise that it is the backbone of the prosperity of the country. Traders have been ennobled, and hold high positions, while the Government has taken a fatherly interest in commercial enterprise, even to the extent of heavy subsidies and loans from the public exchequer. My own experience is, that if you carefully select your traders, as you would do elsewhere, the better class merchant is reliable, but foreigners are often misled by Bantos, or go-betweens, who, for their own ends, introduce dealers of doubtful character, who have nothing to lose and everything to gain, and these are the people that repudiate their contracts if it suits them. The remedy is to study the language and get into closer contact with the right people.

I.—Banking.

One of the most remarkable advances is in the banking system, established not only in the large towns, but practically throughout the country. In 1854 but little specie was in use, and the Government received taxes mostly in

kind, but even then there existed a system of banking to meet the limited demand for the internal transactions. As trade developed, or even in advance of it, national banks were established with a note issue of their own which was convertible into Government paper money, and as the value began to depreciate as the amount in circulation increased, the Government from 1880 refused to permit the establishment of any more national banks. The note issue was withdrawn from those that already existed, and only the newly-created Bank of Japan was allowed to issue notes. Meanwhile, private banks which did not come under the Regulations for National Banks, had increased with the progress of trade and society's demands, and in order to bring them under efficient control, the Banks Regulations Act was promulgated in 1880, and put into force three years later. All are now subject to the provisions of the General Banking Laws.

The Bank of Japan was founded in 1882 as a joint stock company, and has now a capital of 30,000,000 yen. It is privileged to issue convertible bank notes on the security of gold and silver coin and bullion equal to the amount of the notes issued, and further to issue such notes on security of Government bonds and treasury bills, and other bonds and commercial bills of a reliable nature, the amount of the latter not to exceed 120,000,000 yen. This bank is entrusted with the management of the treasury receipts and disbursements.

A gold standard was adopted in 1897, and has done much to establish the credit of the country, and to enable it to borrow foreign capital. The intrinsic value of the gold yen is about 2s. 0½d.

The Yokohama Specie Bank was established in the year 1880, with a capital of 3,000,000 yen, which has, by degrees, been increased to 24,000,000 yen, with 18,000,000 yen paid up. It was formed for the purpose of carrying on a banking business abroad; it has had a highly successful and useful career, and may be regarded as more or less a Government institution in connection with the Bank of Japan. [The slide represents the new and handsome premises of the bank, designed and built by Japanese architects.]

The principal banks besides those already named are:—

The Hypothec Bank of Japan. Capital, 10,000,000 yen, with 3,250,000 yen paid up. This is a mortgage bank for the development of agriculture and industry.

The Industrial Bank of Japan. Capital, 10,000,000 yen, with 3,250,000 yen paid up. The business is to make advances on national bonds, &c.

The Hokkaido Colonial Bank. Capital, 3,000,000 yen. Object: enterprises for colonising and exploiting Hokkaido, the Northern Island of Japan.

The Bank of Taiwan, Formosa. Paid-up capital, 2,500,000 yen. This is a Government bank, and is allowed to issue bank notes.

There are a large number of savings banks, which must have a capital of not less than 50,000 yen. The directors are jointly under unlimited liability during their term of office.

The banks that I have specially mentioned were established for a special object under Government protection, but they are at the same time under strict control. Of banks existing, the total is something over 2,300, which are all under the control of the Minister of Finance, and every bank must, each half-year, prepare and present to this Minister a balance-sheet and other business reports.

Thus it will be seen that very ample facilities have been provided for the financial operations of the country, and it is unquestionably due to this provision that trade in Japan has made such marvellous progress, the total returns for the year 1904, during the war, being:—

Imports, 371,360,738 yen; exports, 319,260,895 yen; or in round figures combined, say £70,000,000.

These figures illustrate the wonderful vitality of trade in Japan. Battles at sea and on land have been fought and won; but has not the country shown the same energy and success in rapidly building up and establishing a trade which, from a comparative point of view, is unknown in the annals of Europe? Does it not denote an industrious and level-headed people? It is claimed—and justly so—that much of this trade is due to foreign initiative; but what would be the result without a hard-working and receptive nation?

In exports, the United States of America is Japan's best customer, being very large buyers of raw silk, silk goods, tea, &c. China is second, Great Britain and her dependencies, including India, come third, and France fourth.

With imports, Great Britain alone leads the list, but is being rapidly overhauled by the United States, though with India and the Colonies she has still a big lead. The United States comes second, and China third, Germany fourth.

Raw silk is the largest article of export, and raw cotton of import.

II.—Rice.

Japan is essentially a rice-producing country, as it is the staple food of the people, and has been so for centuries. The population is about 46,000,000, and the average production of rice 42,000,000 koku, or, say, 6,000,000 tons. Giving about 1 koku per head, this quantity is not sufficient to feed the population, and some 500,000 tons of Rangoon, Saigon, and Siam rice is now imported annually, against which, when the crop in Japan is a good one, from 80,000 to 100,000 tons are exported.

Japanese rice is one of the best descriptions, and has for some years been a favourite table rice in this country. The Japanese are most partial to their own rice, which is of a superior quality to that imported. It was only during a severe famine that they could be induced to eat Burma rice brought into the country by M. Samuel and Co. Since that time a mixture of foreign and native rice has become saleable. The rice is sown on the 88th day from the beginning of spring, in patches, and transplanted a few weeks later during the Nyubai, the period fixed for the early summer rains. The 210th and 220th days from the beginning of spring are regarded as of special importance to the crops. As these days fall early in September when the rice is in flower, and during the typhoon season, considerable damage may be done during a blow. Rice is largely used for brewing the national beverage—Saké. This is usually consumed hot, and is not unlike sherry in taste. The importance to the country of a good crop is manifest, and upon it much depends as to the purchasing power of the people.

III.—Silk.

We now come to the next article of importance, viz., silk, which is produced in large quantities. The export in the raw state is valued at about £9,000,000 annually, the export of piece goods, handkerchiefs, &c., amounts to a further £4,000,000, besides which a large quantity is consumed in the country, as it is worn largely by both sexes. The producing districts are principally the central and northern provinces of the main island. They are usually prosperous villages engaged in rearing the worms and reeling the silk. In many places the primitive methods of working survive, while in others foreign machinery is in use.

The mulberry tree is quite small. The branches are cut off and taken home to strip the leaves. Frequently, in order to take full advantage of the ground, crops of vegetables are grown between the trees, which are pollarded.

The quality of the silk is said to be about equal to that of Italy, although the cocoons are smaller and lighter. This trade is of the utmost importance to the prosperity of the country, and a good crop goes far towards general activity.

IV.—Copper.

Copper is found in large quantities. The most important mines are at Ashio, near Nikko, and at Besshi in Shikoku, but there are several smaller ones. The works which I have visited are furnished with the most modern machinery for smelting and refining, and turn out slabs and ingots of copper 99 per cent. pure. These are largely exported and bring about £1,400,000 into the country.

V.—Coal.

Japan is the fortunate possessor of large supplies of "black diamonds." The quality, however, is not equal to English Cardiff, and during the war, the fleet was supplied to a very large extent from this country. Japanese coal is softer, and burns more rapidly, without giving the same heat. While much of the coal is of a poor quality, several mines produce coal which, as a fuel for steamers, is very satisfactory. It is exported largely to Hongkong, Singapore, Java, and Manila—the total export last year being valued at £1,500,000. Production is about 10 million tons, of which 6½ millions are used in Japan, and 3½ millions tons are exported. Moji is the port of shipment on the main island, and Miike; and Muroran and Otaru on the northern island.

The system of mining is antiquated amongst the smaller mine owners, but there are several very large mines well equipped, turning out quite as much coal as would be obtained under similar circumstances in this country. The time is not far distant when Japan will have China as a competitor in this article.

VI.—Camphor.

Camphor has been produced in large quantities in Japan, and as long as China retained Formosa there was competition between these two producing countries. When Japan acquired Formosa after the war with China, a Government monopoly was established, first

in Formosa, and then in Japan. The production in the latter country has fallen away considerably, while the former has increased. Japan now controls the camphor market, and, under the able management of her officials, has greatly improved the quality of Formosan. The trees are felled and cut into chips. These chips are submitted to a process of steaming, which carries off the fumes to a cooling apparatus. Condensation takes place, and the camphor and oil are afterwards recovered.

So far the forests, in which the camphor tree abounds in Formosa, have not been cleared of the aborigines or head-hunters. Consequently, the production of camphor is fraught with danger, and the workers have to be protected by a military guard. Even with this precaution a number of the workers have lost their lives. These savages were never subdued by the Chinese, and as their homes are in the mountainous forests they are difficult to get at. Head hunting is practically a religion with them, and it is said that no young man is eligible for marriage until he has accumulated a certain number of scalps.

Camphor is used as a disinfectant in its refined state, also to keep moths out of clothing, and, as a medicine, but its principal use is in the manufacture of celluloid. The total export is about 60,000 cwt., of a value of about £500,000.

VII.—Tea.

Tea is a most important product, as it is the beverage of the people, and is largely exported. The plant is said to have been introduced from China in the year 805, but it was for a long time used only by the Buddhists to keep themselves awake during their midnight vigils. A pious legend has been handed down to the following effect. Daruma, an Indian saint of the sixth century, had spent long years in ceaseless prayers and watching. At last, one night his eyelids, unable to bear the fatigue any longer, closed, and he slept soundly until morning. When the saint awoke he was so angry with his lazy eyelids that he cut them off and flung them on the ground. But lo! each lid was suddenly transformed into a shrub, whose efficacious leaves, infused in water, minister to the vigils of holy men. Though tea-drinking was long in vogue at the Court and amongst the aristocracy, it did not come into general use until the end of the seventeenth century. Its use has now become so universal that it is taken at each meal in small cups, without sugar or milk, and is invariably offered to a visitor in token of a welcome. There is a unique ceremony, called the Cha-no-yu, or tea ceremony, given on special occasions by the Japanese ladies, and no girl's education is complete until she knows how to preside at one of these interesting functions.

The plant is generally three or four feet high, and is mostly grown on slopes or dry ground. Picking lasts from April to July, the best leaves being gathered first. By means of charcoal pans, or in some cases by exposure to the sun, the leaves are dried until each is contracted by the withdrawal of moisture, and assumes the colour of a dark olive. For export the leaf is fired until it becomes quite brittle. Japanese tea is not appreciated in Europe, perhaps because of its colour—green, but in the United States and Canada it is in good demand, the exports being valued at £1,250,000.

VIII.—Petroleum.

Petroleum is found in the north of Japan—the Echigo district. The crude oil is heavy in character, and does not produce a very good burning kerosene. The principal refineries are in the hands of two Japanese companies, the Nippon and the Hoden. They, with the smaller works, produce about 60,000 tons annually of the refined article besides the by-products. The Standard Oil Company of America, with their usual enterprise, tried to control this trade by buying large tracts of land, said to be oil-bearing, and by building a large refinery. They were, however, unsuccessful, and have incurred a large expenditure without any result so far, and in that part of the world cannot be said to have struck oil in the ordinary acceptation of the term. It is reported that oil is to be had in paying quantities in the Hokkaido or Northern Island, also at Saghalien, but so far there is no recognised industry in these directions.

The consumption of imported kerosene is in the neighbourhood of 180,000 tons per annum. This quantity, until the advent of Russian oil, was mostly supplied by the United States of America in tins and cases containing about 6 gallons, but since the establishment of the "Shell" Transport and Trading Company, a large quantity of Russian, Langkat, and Borneo oil is imported, and distributed in bulk, thereby cheapening the cost and benefiting consumers. In all the important cities of Japan, electric light and gas are extensively used, but kerosene may still be described as the light of Asia.

IX.—Sundry Products.

Having referred to most of the staple articles of the country, I could add a long list in enumerating such products as antimony, vegetable wax, gall nuts, tobacco, sulphur, canes, and menthol. All these go to swell the revenue of the country, and in being exported provide the funds for goods that are imported.

We must not forget the hundred and one articles, known as curios, such as porcelain, lacquer ware, cloisonné, screens, &c., as I think I may say that it was partly due to these works of art that Japan and her clever people first became so well-known in Europe and America. I remember some years ago, when everybody in this country who could afford to do so was accumulating Japanese curios, a witticism of Toole's, as follows:—"Everything is so Japanesy that it is enough to make a chap uneasy." Little did the public think, when they laughed and enjoyed the joke, that this country would become so Japanesy that we should, by treaty, become allies.

X.—Shipping.

Now, the production of so many articles of export requires oversea conveyance, and Japan has not lagged behind in this important branch, which, from time immemorial has held a prominent place in the commerce of the country. Japan, being composed of a series of islands, has always produced a large number of fisher folk, and these, as our own experience teaches us, make the best sailors.

Will Adams built ships for the Shogun, one of which made extended voyages, and went as far as Mexico. This enlightened policy was reversed when Iemitsu Shogun issued an edict in the year 1636 restricting foreign merchants to the two south-western ports of Nagasaki and Hirado, and all foreign priests were expelled from the Empire, while Japanese subjects, under pain of death, were forbidden to leave the country. In order to enforce this decree more effectually, all large sea-going vessels were destroyed, and only small junks, sufficient for coasting purposes, permitted to trade. Thus Japan's shipping was crippled for over two centuries. The number of coasting junks was, however, considerable, communication being mostly carried on by water. With the lapse of time these junks doubtless increased in size or tonnage, and are what the foreigner found when he visited Japan in the nineteenth century. These vessels are still to be seen in Japanese waters. They carry a large square sail, and do not make rapid progress unless running before the wind.

When the feudal government fell, the shipping restrictions disappeared, the new Imperial Government took a keen interest in the development of the mercantile marine, and encouraged the building or purchase of vessels on foreign lines. Private enterprise, about the year 1870, started a steamship line, when Mr. Iwasaki Yataro commenced to run vessels of his own to trade between many of the coast ports, and laid the foundation of what was afterwards known as the Mitsu Bishi Steamship Company. These steamers were placed under the command of European captains. The engineers were mostly Scotch, and the officers European, while the crews were Japanese, the directors and agents at the ports being likewise European. This company worked with much success until an opposition line was started, and after a competition ruinous to both companies they amalgamated and formed the now well-known Nippon Yusen Kaisha, or Japan Steamship Company. This company now own some 74 vessels, tonnage 247,902 tons, which not only carry on a large coasting trade, but maintain regular lines between Japan and Europe, America, Australia, Java, the Philippines, and British India. Although some of the old European officials remain on the steamers, they are gradually being replaced by Japanese.

The next company of importance is the Osaka Shosen Kaisha. Their trade is mostly domestic, and includes a line between Formosa and Hongkong, and Japan and Formosa. They have some 87 vessels, with a tonnage of 50,229.

Another company of recent formation, but one that is likely to grow—the Toyo Kisen Kaisha—runs steamers, with excellent passenger accommodation, between Hongkong, Japan, and San Francisco. This company is now building two large passenger and cargo boats of about 7,000 tons dead weight, at the Nagasaki works of the Mitsi Bishi Company. They are to be used in the Pacific trade.

A large number of small companies also exist. These have multiplied during the late war, as they found that buying steamers, transferring them to the Japanese flag, and then chartering to the Government, was a lucrative operation.

There can be no question that the mercantile marine has done much to stimulate the commercial growth of Japan, as before

the advent of railways, it brought the most important districts into touch with one another and enabled them to move their produce expeditiously to the then treaty ports.

So important did the authorities consider the establishment of steamship lines, carrying the Japanese flag to all parts of the world, that on the conclusion of the China War, 1894-5, a law was passed granting most liberal subsidies to foreign-going vessels, which were to be available as transports in time of war. The amount thus expended is a large one for a country whose export trade is of comparatively recent growth, and it is questionable if it will pay to continue it. The only remark I can make is that it gives the Japanese company a decided advantage over its less fortunate foreign rivals.

The construction of dry docks, building, and repairing yards has not been neglected. Steamers of any size can now be docked in Japan. Many large and well-made steamers have been turned out at the yards, and these vessels are now employed in the service of the big steamship companies. The slide represents the *Hidachi Maru*, built at Nagasaki. This vessel, owned by the Nippon Yusen Kaisha, has made several trips to Europe, and it may be remembered that in the early stages of the war she was sunk by the Russian Vladivostock fleet.

The cost of building steamships in Japan is more than if built in this country, but Japan does not stick at that, but says:—"We want to build our own vessels, and with experience the time will come when we can do so as cheaply as anybody else." The Government rightly fosters this enterprise by offering a larger subsidy to home-built vessels. It is their policy to encourage national development, although the initial bill may be a heavy one.

While on the subject of sea-going vessels I should like to refer to the Government dockyards and arsenals at Yokosura and Kure. The first-named is near Yokohama, and was started under the supervision of a French naval engineer, but has since been extended and increased without the assistance of a foreign expert. The second is, I understand, one of the finest in the world, and was built entirely by Japanese engineers, they having learnt their lesson so well that they no longer require the services of foreign instructors. War vessels have been built and successfully launched at these yards, and in the near future Japan will undoubtedly herself construct a large number of warships such as have hitherto been purchased in this country.

XI.—Railways.

Having dealt with one branch of transport, and (for Japan as an island power) the most important, I will now proceed to railways. Here again the Government was to the fore, and with the aid of English engineers a line of 18 miles was constructed between the capital—Tokio—and Yokohama, and opened in 1872. The Kobe and Osaka line followed. Finally, without foreign assistance, the line was constructed along the Tokaido, or eastern highway of Japan, and in 1889 through communication was opened between Tokio and Kobe, which had hitherto been maintained by sea. In the meantime private companies sprang into existence, with such important railways as the Japan Railway Company, serving the north of Japan, the Kyushu and Sanyo in the south-west. These lines practically complete a through system from the north to Nagasaki in the south, with this exception that the Straits of Shimonoski have not yet been bridged. There are many other private lines, such as the Kansai. These railways are well managed, and in the debentures which have been, and will be, floated in this country, offer a safe investment when authorised by the Japanese Government. The total mileage is now over 4,500 miles. The gauge is narrow, viz., 3 feet 6 inches.

The locomotives are of British and American manufacture. The former predominate. The carriages, now built in Japan, are in compartments for third-class, and the long bogie carriages for first and second class. The trunk lines also run sleeping and dining cars on the through trains. Time is, on the whole, well kept. Fares are, as compared with this country, cheap, but like everything else in Japan, these show an advancing tendency, and have been much increased of late years. The people are born travellers, and the passenger traffic on all the railways is very heavy. It is amusing to observe the difference between old and young Japan. The latter are all bustle, and regard time as money, while I have often seen individuals of the old school arrive at a station some hours ahead of the time they believe a train for their destination is likely to leave. Goods traffic is growing in importance, but on account of the very mountainous formation of the country, there is still a large proportion borne by water round the coast.

XII.—Osaka Harbour.

This big scheme has been carried out in recent years, in order to bring the second largest city in the empire into direct communication with ocean-going vessels. Hitherto Kobe has been the port of discharge, and goods had to be sent on by rail. With the advent of the harbour, and a waterway of sufficient depth to admit of the entry of large steamers, goods can now be landed at Osaka, where there are quays, docks, sheds, and warehouses of the most improved type, and as such will no doubt attract much of the shipping trade that was centred in Kobe. This important engineering work has been designed and built by Japanese engineers, the cement used being manufactured in the country. For the cost of this work the municipality, with consent of the Government, raised a Six per Cent. loan for 17,000,000 yen. The firm of M. Samuel and Co. bought 3,500,000 of these bonds in 1902, and a large quantity have since been placed in this country—probably half the total amount.

XIII.—Manufactories.

The largest industry is textile, there being some 4,537 factories of various sizes engaged in this trade, the majority being centred in and around Osaka. These are mostly worked by steam power. The Kanaga fuchi spinning mill, shown on the screen, is located near Tokio. Spinning has on the whole proved profitable, but has its ups and downs as in Lancashire, which at one time supplied all Japan's needs in this direction, and still continues to do so to a smaller extent. Cotton is not much grown in Japan, but is imported from India, America, and Egypt.

Other factories and works consist of paper mills, breweries, sugar refineries, rice and flour mills, cement, gas, and electric light works, shipbuilding, &c., and complete a total of 6,274 works employing some 480,000 hands. The wages average 33 sen—8d. per day for male operatives, and 20 sen—5d. for female. The scale of pay is rising and will continue to do so.

With regard to the foregoing works, I might mention that paper mills, of which one is the Fuji, produce paper similar to that manufactured in Europe. The Fuji mill is worked by water power and quite a number of industrial works are driven by this motive power, there being many mountain streams that can be, and are, utilised for this purpose.

Breweries are of comparatively recent growth, due to a good demand for light Lager beer, which was formerly imported, bottled, from Germany. This industry is a growing one.

Sugar refineries are certain to succeed, being protected by a heavy duty on importations of refined, while raw sugar is admitted on a much lower basis.

The quality of the cement produced at cement works is good, and much cheaper than the cost of the imported article. The result is that Japan not only supplies her own needs, but competes in the markets of the East.

There are some 200 shipbuilding yards. Many of them, however, are capable of turning out only vessels of very small tonnage.

Japan is inclined towards Protection, and her tariff already makes it difficult to compete with some articles that are manufactured in the country. At the same time, as I have already shown, she is a good customer of this country, and is a large buyer of machinery, iron and steel, textiles, drugs and chemicals, glass, metals and metal manufactures, paper, &c.

The views which I am now about to show represent the Imperial Iron and Steel Works at Wakamatsu. These have been recently erected, and include departments for pig-iron, fitted with coke ovens and blast furnace plant, steel works with mixed Bessemer and open hearth plants, foundry and rolling mills, with blooming and rail mill, large, middle and small bar mill, sheet mill, and middle and large plate mill plant. In addition there are a central pumping station, an electric power station, repair shops, &c.—in fact a most complete establishment, fitted and equipped by the Government at a cost of 19,200,000 yen. The position is excellent as regards supplies of coal, three mines in the immediate vicinity having been purchased. It is estimated that 100,000 tons of hematite iron ore will be obtainable annually in Japan, and that from 50,000 to 70,000 tons will be imported from Hupeh, China, to complete the requirements. During the late war this factory was used for the production of war materials, and has also manufactured 25,000 tons of rails for the Seoul-Fusan and other railways, and over 6,000 tons of light rails.

Monopolies.

The Government has three monopolies, viz.:

1. *Tobacco.*—The monopoly relating to leaf tobacco only, came into force in 1898, the cul-

tivation being left in the hands of private growers. This was followed, in 1904, by the monopoly of cigarettes and cut tobacco, thus placing absolute control in the hands of the authorities. All private works were taken over at a valuation. The screen shows you the former factory of Murai Brothers, now a Government undertaking. This article produces a revenue of 32,000,000 yen. There is a large consumption of pipe tobacco, smoked in small pipes made of metal, or of bamboo with a metal bowl and mouthpiece. These give about three whiffs to the smoker, the tobacco and ash being knocked out and the pipe constantly refilled. Supplies are grown in the country, and being of a light consistency are suitable for cigarettes, which are now in great demand, some being made with American-grown tobacco, which, prior to the monopoly, were largely imported in a manufactured state. Cigars are imported mostly from Manilla. The consumption is a limited one.

2. *Salt*.—This was taken over for revenue purposes, and with the object of improving and developing the industry. It is expected to produce a revenue of 16,000,000 yen.

3. *Camphor*.—Camphor has already been referred to. This product is mostly consumed out of the country. The firm of M. Samuel and Co. are for a term of years entrusted with the sale abroad.

Industries.

Besides the works already referred to, we must not omit the farmer, who is an important factor in the industries of the land. Farm lands are almost entirely agricultural, and their owners are hard-working men who are satisfied to make a mere living out of the land, of which they are the owners, or nominal owners by paying the Government a Land-tax. The Japanese are experts at raising crops, and get as much out of the ground as ingenuity and circumstances will permit. The system adopted in laying hill-sides out in terraces and cultivating them, shows how carefully every available inch of ground is availed of. The country is of a volcanic formation, and so mountainous that a very large area cannot be cultivated. The grass, such as it is, is unsuitable for sheep, and they cannot be reared. Bullocks thrive upon the coarse bamboo grass, and produce excellent beef, the best to be had anywhere in the East.

Fishing.—This industry is of importance, as the extensive coast-line lends itself to the art, of which the Japanese are no mean experts. It is a fish-eating country, and if, as is popularly supposed, fish diet produces brain power, we have a clue to the people's greatness. The fish is of the most varied description, and very palatable. Beyond this, the catch of herring and sardines is utilised to manufacture manure for the rice fields, and oil for export.

The indications given you may not have been sufficient to show that the land of the Rising Sun is a most pleasant country in which to reside. Let me, therefore, say that the visitor is always welcomed and charmingly received, and a trip to Japan cannot fail to be instructive and of interest. So thoroughly do the Japanese study the wishes of their guests that I have heard a visitor express a desire to feel an earthquake, and he gets it, but he does not ask for an encore. The people are studiously polite, not only to the stranger, but to one another, and one cannot help feeling a passing regret that, in order to keep pace with the twentieth century, so many of the polite old-world customs of the people are dying out and being replaced by the Western nod or a shake of the hand.

It is sometimes said that the Japanese are splendid at imitation, but not initiative. There I beg to differ. They certainly have the faculty of grasping how a thing is done, and copying it to perfection, even improving upon it, but they are at the same time inventive, and have produced quite a number of valuable ideas. Take, for instance, the Muratta rifle and Shimose powder, both of which have shown their utility in the late war. This nation have been carefully assimilating for years the knowledge of Western ideas, and making use of the best of them. I remember some years ago being invited by the authorities to visit a prison newly built in Tokio. It was in every respect, both from a sanitary and humanitarian point of view a model prison, and very much in advance of any gaol then in the country. What struck me most about it was that it was built after visiting prisons in almost every country, the Japanese having selected what they considered the most advanced system from each and made it a harmonious whole. Thus one saw England, America, France, Germany, Italy, all represented in that prison. The idea was not to build a prison in foreign style, but to obtain the best and latest developments, and use only that portion which was the most up to date.

And so it is with everything that Japan takes

in hand, there is a thoroughness as regards research that merits the highest approbation. Mistakes must inevitably be made, as no mortals are infallible, while much still remains to be done. Japan has been learning from the West, and will continue to do so, as long as there is anything worth knowing. We must not on our part lose sight of the fact that she can teach us some lessons that might be of value, both in the fields of peaceful commerce and of war. Let us, therefore, take full advantage of the alliance, which should bring the people (and I may say has already done so) of both countries into closer relationship, and in closing I shall express a hope that the treaty, which has secured an open door to all countries in the markets of the East, may prove to be a strong and lasting bond between this country and Japan.

[The paper was illustrated by lantern slides kindly lent by Mr. S. Kato, of the *Anglo Japanese Gazette*.]

DISCUSSION.

The CHAIRMAN said that the paper which had been read was a most interesting and instructive one. Mr. Mitchell, during his sixteen years' residence in Japan, came in touch with every class of the people, so that his knowledge of Japanese things was very great, and the nature of his business had given him special opportunities of investigating the subjects to which he had referred.

Sir MARCUS SAMUEL said he had the great honour of being on the Council of the Society of Arts, and, with that catholicity of interests which distinguished them, they were extremely anxious that the great advance and progress which Japan had made should be known. With that object in view, Sir Henry Wood asked him if he would introduce a gentleman who could demonstrate that the day had long since passed when Japan was known only in the category of a producer of curios; but nobody present would doubt after hearing the extremely able and interesting paper, that that stage had long since passed away. He had been intimately connected with Japan, and although he knew a great deal about its progress he confessed it was a matter of astonishment to him to find how enormously the trade of the country had grown. Twenty years ago it was only three millions a year, whereas, if the figures of the first six months of the present year were maintained, a trade of over 90 millions would be done this year, an astonishing progress, and one of which any country in the world might be proud. Mr. Mitchell had not touched upon one or two interesting facts which showed the thoroughness with which the Japanese carried out their ideas. The Japanese had always been opposed, upon grounds on which they had many sympathisers in England, to the great evil introduced by the Chinese, opium smoking; and when they took over Formosa they determined that, as far as they could, they would gradually stop the sale of opium. They determined, in the first place, to stop the sale forthwith, but they found that the result would be disastrous, because the more delicate people who had contracted the terrible habit of opium smoking would have died in large numbers. It was, therefore, decided to allow the consumption to go on, but to take over the management of opium as a Government monopoly, not for the purpose of making money but gradually discontinuing the import. The Government was met with a good deal of ridicule, it being said that they posed as people determined to repress the traffic, and yet when they got the industry into their own hands they would make a profit out of it. Nothing of the sort occurred, the Japanese Government stuck to their guns, and the consumption of opium in Formosa was being gradually discontinued. He had not the slightest doubt that the humanitarian policy carried out by the Japanese Government in that connection had proved an excellent and successful experiment. The Japanese took Formosa from China, and he was afraid His Excellency, the Chairman, would agree with him that it had not been a paying investment. It had been found, however, that commercially Formosa occupied one of the most important positions in the world because it produced camphor, which, however, promised to become absolutely extinct. With the childish idea which caused the old woman to kill the goose with the golden egg, the Formosans were rapidly destroying every camphor tree in the country, so that in a very short time camphor would have been a thing of the past. The Japanese Government interfered, and not only stopped the cutting of the camphor trees, but initiated a system of planting forests of young camphor trees, which would bear fruit and would be a lasting record of the great ability with which the Japanese Government carried out the task they undertook. There was no doubt that Korea had a very great future before it, and he hoped the Japanese Government would undertake the entire administration of that most interesting country. His firm were among the first to engage in trading operations there, and he remembered that on one occasion they purchased a large quantity of Korean rice. Some of the people very much objected to what they considered the food of the country being exported, they looked upon it as a sort of robbery to deprive poor people of their food; and the upshot was that the unfortunate contractor who sold the rice was killed in the streets of Seoul. Great progress had been made since then, and, under the wise guidance of the Japanese, he hoped Korea would become a very considerable exporter of grain. The Japanese since then had taken over the control of Manchuria, and he did not think they had ever conferred a greater benefit upon the world than by doing so. He hoped the Japanese would retain the government of a very large portion of that fertile land, because he believed it would become the

granary of the East. There were enormous possibilities of wheat plantation in the country; the grain and flour which now came from California could be raised there; and already, under the feeling of security which the Japanese Government had inspired, there were considerable projects for erecting flour mills. Mr. Mitchell had mentioned how thorough the Japanese were in all they undertook. They did not quite realise the magnitude of their requirements in connection with the war; they thought they would be able to produce all the requisite blankets and army cloth, but very soon found it was not the case. He was happy to say that they came to England, and kept a great many of the mills throughout the North of England occupied for many months, day and night, in supplying their requirements. But the point he wished to emphasize was that they sent with their orders a specification so complete and clear that it astonished the English manufacturers. Not only were the exact textures required given in the specifications, but indications were given for the dies and chemical tests; and it was a great revelation to the manufacturers to find how thoroughly the Japanese went into the matter. He wished the English Government would take a lesson from the Japanese, and learn once for all that the best was the cheapest in the end, and that, following the lines of the Japanese, they would eschew "shoddy," and get the very best articles they could for our soldiers. The Japanese were essentially progressive. Photographs had been shown of the Osaka Harbour Works, an extraordinary undertaking which had far more than justified the hopes of its projectors, viz., the municipality of Osaka. There was undoubtedly a great field in Europe for finding the capital for the municipal developments in Japan. English people were crying out a good deal about the expenditure put upon the rates on acconnt of the vast projects carried out by municipalities, but he had not the slightest fear that Japan would misuse money that was lent to her for such purposes. So long as the Japanese Government exercised their paternal care and undertook the supervision of all loans issued in Europe, he was sure that whilst English people would thus benefit themselves they would do a great deal of good to the Japanese in enabling them to move more rapidly than they would be able to do if they had to divert their funds from commerce; and he hoped that the opportunities that had been, and would be, given to this country to aid in that way would be fully availed of.

Mr. BYRON BRENAN, C.M.G., stated that what had brought home to him more than anything else the wonderful progress which had been made by Japan in the last thirty years was his own personal experience. Thirty years ago, after he had succeeded, with a great deal of self-denial and economy, in saving a few hundred pounds, he invested them in a Japanese external loan yielding 9 per cent. interest, while only a few days ago the Japanese Government put a 4 per. cent. loan on the London market, and he was a very lucky man indeed who managed to secure any of it. That showed the progress of Japan in a nutshell. The wonderful progress made commercially was in a large measure due to the inherent sterling qualities of the people, but in a large measure to the steps taken by the Government in developing and fostering industries, in seeking new opportunities and new markets, and in "forcing the pace." For some years any observer must have noticed that whenever he met a Japanese subject outside his own country he was an official agent, keenly on the scent for some valuable information; and as soon as he picked it up, down it went in the notebook with which he was always armed. In that respect he must confess that Japan was not a free trading country; because after that agent, thirsting for information, had squeezed out of his interrogator all he could get, and his informant in return asked the Japanese gentleman a few questions about things in Japan, the thirst for information again came over him, and with an innocent look in his eyes, he would inquire why his informant wanted to know about such things, and no information could ever be got out of him at all. If one chose to study the official publications of Japan in the right way, there was a great deal of interest to be found in the statistics, and even a good deal of sentiment. It was not only the case that right through the last 30 years there was a regular increase in the total imports and exports, but the most remarkable thing to him was that the nature of the constituents of the imports and exports was steadily changing. For instance, in imports the ratio between the manufactured and unmanufactured articles was steadily changing to the advantage of the unmanufactured article; whereas in the case of exports it was just the other way, the proportion of the total taken up by manufactured articles was constantly increasing. One very striking instance of that was cotton. The quantity of raw cotton imported into Japan had increased immensely, and, simultaneously, the quantity of manufactured cotton exported, chiefly cotton yarn, had also increased. A curious thing was that a great portion of the raw cotton was imported from China, and was then returned to China in the manufactured state of yarn. That was where the statistics were tinged with a certain amount of sentiment, because every thousand bales of raw cotton which went into Japan, meant a greater number of Japan's gentle daughters going up in happy bands to their mills, and every bale of manufactured yarn returned to China was an indication of the toll which a badly governed country had to pay to its more intelligent neighbour. A great portion of the merchandise now supplied by Japan to China was what China, with equal chances, might equally well supply for herself, and even more cheaply; but China showed as great ingenuity in stifling industrial development as Japan had in fostering it. Sir Marcus Samuel had mentioned the lady who killed the goose with the

golden egg, but in China the unhappy goose was killed before her egg was laid at all; she was killed early in life for the sake of the half-formed egg inside her. That was all to Japan's benefit: but some day they might hope that China would be governed in the same intelligent way as Japan, and then the condition of commerce between the two countries would be changed. A great many things which China now bought from Japan she would then produce for herself, and she would also be a rival to Japan in fields where that country had it entirely her own way. That would mean a wealthier China; but he thought they might trust the Japanese to be able to derive as great a benefit from a wealthy neighbour as she now did from a poor one.

Mr. J. H. LONGFORD said that no subjects of the Emperor of Japan could look with more satisfaction upon the results of the great development of Japanese trade than did Sir Marcus Samuel and Mr. Mitchell, and one could, therefore, understand the enthusiastic terms of admiration in which they had referred to the country. But, apart from the more practical development of Japan's industries, there was a good deal of romance in the question. Romance was a thing which was not usually associated with trade, but the whole history of the development of Japanese trade to the great magnitude which it had now attained was characterised by several important elements of romance. Thirty years ago Japanese soldiers fought with bows and arrows and swords; and the Japanese sailors, who had recently successfully navigated huge battleships in a great war, used poor country boats which were utterly incapable of facing any storm on the open ocean or of making their way against adverse winds. From those beginnings the present scientific soldiers, and the equally scientific sailors of Japan had grown. The merchant of Japan had sprung from even more unpromising beginnings. When he first went to Japan, the country was split up into independent principalities. A few years previously she had not only no foreign trade whatsoever, but absolutely no internal trade. Every principality was, in itself, entirely self-supporting; there was scarcely any postal communication, there was no interchange of commodities, and there was scarcely any interchange of money, the result of that parochial trading being that the mercantile spirit was completely choked in the Japanese people. When foreign merchants came to the country bringing their great ideas of trade with them, the persons who came to the open ports were of a very low standing, and they brought with them all the faults of adventurers of the very worst class. Those people brought a very unenviable reputation upon Japan, which for a considerable time interfered with the development, in its proper channels, of Japanese commerce. Things had now changed however; and, under the enlightened tutelage of the Government, instruction was being given in every line of trade throughout the country. Young Japanese of the best birth were commencing to share freely in commercial pursuits, and a great change had thus come over the whole spirit of Japanese commerce. From being a degrading occupation it had now become an honourable and noble calling. He had no doubt that in a very few years the Japanese merchant would be as worthy of close association with the very best type of English merchant as the Japanese soldier and sailor were worthy of ranking as the equal of the very highest types of the British army and navy. English people professed a great deal of gratitude to the Japanese for having maintained and preserved the open door in China, but in his own heart he felt there was not a particle of gratitude due to them in any way. He believed that the Japanese were so perfectly confident in themselves, so sure of their industry and organisation, that before another ten years had passed not a single soul would pass through that door but themselves. They considered that the whole trade of China was assured to them in the future; and he must confess that, looking at their past history, considering how earnestly and thoroughly they were working at present, and how in the past ten years they had extended their trade from 30 millions to 90 millions, and their manufactured exports from 2 or 3 millions to 12 or 15 millions, it was not a very wild suggestion to make that, before another ten years had passed, they would obtain a commanding position in the commerce of the East, England, Germany, and America being nowhere.

On the motion of the CHAIRMAN, a cordial vote of thanks to Mr. Mitchell for his able and interesting paper was carried unanimously.

Mr. MITCHELL, after thanking His Excellency for the kind manner in which he had proposed the vote of thanks, and those present for the way in which it had been received, said he was sure that the audience was deeply indebted to Viscount Hayashi for presiding over a meeting at which a paper had been read on his own country, on which he could have given a great deal more useful information than the author. All English people deeply appreciated the interest taken by His Excellency in the affairs of this country; they heartily congratulated him on being raised to the rank of Ambassador, and trusted that he would remain in England for many years to come.

COMMERCIAL AGENTS FOR THE COLONIES.

The following has been received from a member of this Society who has long been resident abroad:—

In the issue of the Society of Arts *Journal* for November 10th there appears a note on a paper contributed by Mr. C. Just, on the proposed creation of a service of commercial agents, to reside in British possessions, whose duty it would be to report to the Board of Trade on openings for British trade, and, in effect, to do the work now done in foreign countries by British consular officers.

The lapse of years and the changes that have taken place in transportation and telegraphs have brought nearly the whole world within twelve hours' communication with London, so that the duties of Consular officers can no longer be looked upon in most countries as in any way diplomatic, and it would seem that they should, therefore, be treated much more as commercial agents by the home authorities than they have been hitherto.

Under these circumstances, it is suggested that, as probably when the office of Secretary of Commerce is instituted, as is proposed, the Consular offices will come under his jurisdiction, as will the proposed commercial agents, these two services should be united, and that interchange of officers between the Colonies and foreign countries would be most beneficial to our trade in general, especially if promotions to and tenure of important commercial posts were contingent on good and satisfactory work.

There are at present about 115 Consul-Generals and Consuls, of which 93 are in the general service (the others being diplomatic or unpaid), and of these 93, about 50 only are really of great commercial importance, thus leaving a great many posts where those who were not able to fill the commercial posts, could serve without any hardship.

The number of Consuls or Agents necessary for the Colonies would be about two for Australia, one for South Africa, two Canada, one New Zealand, one West Indies, and two for India.

NORTH OF NULLABAR BARS.

The Society has received from the Government of South Australia a copy of the report of Mr. F. R. George, on his prospecting expedition North of Nullabar Plains. Mr. George was appointed by the Minister of Mines to command an exploration expedition whose primary object was the search for gold and other valuable metallic minerals. The expedition left Adelaide on June 28th, 1904, and was recalled on October 22nd. It accomplished little. Mr. George could find no new gold or mineral field, and in his report to the Government, he regrets that "such a well equipped party should have been restricted to a country where there is no probability of gold or other metallic minerals being made." The following extract from the report is repeated, in varying words, "We napped over all the exposed rocks, and dollied up and panned off numerous samples, but were unable to find a trace of gold, and I am of opinion that they are not auriferous. On the other salt lakes and swamps met with in travelling to this place exposures of jasper, quartzite, and porcelainised sandstone occur, but nothing in the way of metalliferous rocks was met with." The country examined lies between the northern border of the Nullabar Plain and south latitude 28° 45′, and between the western boundary of the State (E. longitude 129° and E. longitude 132°.

HOME INDUSTRIES.

Railroad Ties.—The increase in the price of all kinds of timber in the United States—nearly 100 per cent.—has compelled railway managers to seek artificial means of prolonging the life of ties and poles. Some of the leading western railroads have planted large acreages of private forests with quick-growing varieties of trees, but quick as they may grow, it must be years before they are available for the requirements of the railroads, and, meantime, preservative treatment has to be tried. In lesser degree, the same problem has to be solved by our own railway managers, who are, no doubt, following the American experiments with interest. The source of decay and decomposition is in the air and water rather than in the wood itself. Minute animal or vegetable organisms floating in the air or water come in contact with the albuminous substances in the wood, and under favourable conditions of heat and moisture multiply rapidly and destroy the timber. To prevent this it is necessary that an antiseptic with germ-killing properties be applied to the surface of the ties, and most of the American railroads are now treated by the zinc-chloride process, but some have tried the zinc-creosote and the zinc-tannin processes. Unless the life of the ties can be increased considerably, the cost of the chemicals renders the work unprofitable, but each year gained on every tie represents a great economy on the large lines. Many millions of dollars can annually be saved by bringing the average life of the abundant soft woods up to that of the hard woods by using preservatives of a cheap nature. The cultivation of forests of soft woods for railroad ties is an important branch of American railroading since their growth is much more rapid than the hardwoods, and if by being treated with chemicals they perform equally good work, the American tie problem will be partly solved. The railroads interested in the subject now employ dating nails, which are driven in the upper side of every tie treated. In this way, the track foreman is enabled to keep an accurate record of the age of every tie taken up.

Preferential Timber Rates.—A good deal is being said just now about forestry schemes to be initiated and carried out by the Government, partly with the object of assisting the unemployed. As mentioned above, a somewhat similar movement, but directed by private enterprise, is occurring in the United States, and there can be little doubt that in certain parts of the United Kingdom, timber, as a farm crop, would pay in the long run better than any other crop. The average imports of hewn and split timber for the three years—1890 to 1892—amounted to 7,083,388 loads, valued at £15,357,199; in 1900 they had increased to 9,899,142 loads, valued at £25,870,934, and unless we can make advantageous arrangements with Canada the cost of timber in the near future is likely to increase even more rapidly than has recently been the

case. Home growth of timber is to be encouraged on many grounds. There are about 21,000,000 acres of poor land and waste in the United Kingdom, much of which might be planted with profit, but it is to be feared that little will be done unless by Government. The initial expense is heavy, the return long delayed. Meantime a committee of the Royal English Arboricultural Society has collected much useful information with respect to the differential rates levied by railway companies for foreign as compared with English timber. A large additional amount of British timber could be used for poles, pit-wood, carriage, coach and wagon building, if it were systematically and scientifically grown, and growth ought not to be discouraged, as it would seem to be at present, by differential rates in favour of the foreign product. If the committee are rightly informed, the differences range from 2s. 2d. to about 11s. per ton, and the instance is given of Hull to which place foreign Odessa round ash is carried at 8s. 4d. per ton, delivered, as against Birmingham to Hull, where English round ash is conveyed at 23s. 6d. per ton, station to station, with a further 3s. 6d. per ton for cartage.

Rubber Supplies.—Opinions differ considerably as to whether the supply of rubber will keep pace with the ever-increasing demand; but if Sir Harry H. Johnston is well informed, a very large supply may be expected from Liberia, which hitherto has not exported any rubber worth mentioning. In a report addressed to a company which has obtained a large concession of rubber country in Liberia, Sir Harry Johnston speaks of "an enormous amount of rubber merely waiting collection;" and he has "no hesitation in saying" that within six years the property in question may have "2,500,000 cultivated rubber trees, yielding African rubber of excellent quality." Another report speaks of "at least 20,000 square miles of Liberia" being "dense rubber forests," and a third refers to Liberia as "a perfectly wonderful rubber country" with "several rubber-bearing Lianas new to science. The country seems to be the home of the rubber-bearing Apocynacæa." Statements of this kind must be received with great caution, but it is reasonable to assume that if the rubber forests in Liberia which are known to exist are exploited scientifically they will furnish a substantial addition to the available rubber supplies.

Wheat Imports.—As was to be expected the imports of wheat last month from Russia show a large decrease. According to figures compiled by the Central Statistical Committee the harvest yield of the present year in fifteen provinces of Russia, as compared with the mean yield of the previous five years, shows a diminution of 30 per cent., and the comparison is the more significant in that these five years include two years of scarcity. It does not necessarily follow that because crops are short in Russia, or in India, there is a corresponding shrinkage in exports; the contrary is generally the case, but having regard to the present chaotic condition of Russia it must be expected that there will be serious shrinkage of exports, and the November imports of wheat from India, Australia, and Argentina all show a large decline. Fortunately the United States have come to the rescue, the receipts from them during the month amounting to 1,423,000 cwt., as against 132,000 cwt. in November, 1902. The grain crop in the United States this year was a record one, and the exports to the United Kingdom are likely to show a large increase as compared with last year. The Canadian exports, too, may be expected to show substantial improvement, but having regard to the shrinkage from other quarters, any considerable fall in price is not to be looked for. The excess in one country is balanced by the shortage in others.

Gas v. Electricity.—It is not only in London that the struggle between electricity and gas is acute. In Birmingham electricity and gas are struggling for the capture of the smaller manufacturers who require a power supply of from 1 to 20 h.p. daily. The charges per unit for electrical energy are to be reduced from 3d. to 2d., and from 2d. to 1½d., according to the quantities taken, whilst the gas charges will drop from 2s. 6d. to 1s. 10d. and 1s. 7d. per c. ft., according to quantity. It is thought that the new charges will entail initial losses in both departments, but that they will stop the present tendency to adopt power gas in its more recent improved forms.

Motor Omnibuses and Electric Tramways.—The rapid increase of motor omnibuses is bringing to the front questions with which Parliament alone is competent to deal, and which may be expected to attract the attention of the Legislature before long. It is pointed out that whilst all electric tramway cars are required to carry life-guards, so that a person knocked down has a chance of not being run over, motor omnibuses are not required to carry life-guards, and do not carry them. Then as to speed, it does not seem that the motor omnibus is under the same rigid limitations as the electric tramcar, and whilst tramways are heavily rated on their permanent way the motor omnibuses do not at present contribute to the upkeep of the streets they use. Moreover, the motor omnibus may go anywhere, whereas the tramcar is excluded from certain districts. All these matters will no doubt be equitably adjusted as time goes on. At present the motor omnibuses enjoy obvious advantages as compared with the tramways, and from the shareholders' point of view, nor is it likely that the Legislature will do anything to completely neutralise these advantages. It is to be hoped that invention will soon be able to lessen the noise made by the motor omnibus, for with the prospect of hundreds of additional omnibuses being put upon the streets of London during the next twelve months, the resulting noise will be almost unendurable if nothing is to be done to subdue the present rumbling and wailing.

Jute.—Although the trade returns for November show a large increase in the imports of jute—72,752 tons as against 58,531 tons for the corresponding month of last year—the jute mills in India have decided upon running short time for lack of fibre, which is plentiful enough at the several stations up in the districts, but from want of communication with Calcutta, the sole seat of the manufacturing industry, cannot reach the market with sufficient regularity to keep the machinery going. Strenuous efforts are, however, being made to improve communications and there will be a very important gain to inland transport, and especially to the jute mills, when the scheme for more closely linking up Calcutta and Eastern Bengal, Assam and Cachar, has been carried through in its entirety. The importance of the jute industry to India may be gathered from the fact that last year the value of the exports amounted to 11,96,56,462 rupees, 40·1 per cent. of the total shipments coming to the United Kingdom, nearly half of it being re-exported. But India will do well to remember that if cultivators do not take adequate account of the manufacturer's needs, there is plenty of suitable ground for the cultivation in other countries. There is a large area in the lacustrine of Nicaragua, up the Orinoco and the Amazon, and even the Mississippi, said to be quite equal to that of Bengal, and almost identical in climate, soil, and rainfall. If the Americans entered into serious competition, India might well lose a large portion of her European trade in jute.

OBITUARY.

Henry Edward Newton.—Mr. H. E. Newton, who died on 22nd November at the age of 62, had been a member of the Society of Arts since 1885. He was the eldest son of the late Mr. William Edward Newton, of the firm of Newton and Sons, Patent Agents and Mechanical Draughtsmen. He was educated at King's College School. Subsequently he went to Australia, but did not long remain there. He spent some time in Paris and was engaged in the erection of concrete buildings, at that time not a very usual construction. Finally he settled down as assistant to his father and uncle who then represented the firm of Newton and Son, and on the death of his father about the year 1877 or 1878 he was taken into partnership. The old-established firm of patent agents, in which Mr. H. E. Newton was a partner, was founded about the year 1820 by his grandfather, Mr. William Newton, a globe maker, land surveyor, and mechanical draughtsman, at 66, Chancery-lane, who added the profession of patent agent to his other occupations. "Newton's London Journal of Arts" was started in 1822. The name of Newton and Sons was adopted about 1840, when Mr. W. Newton's two sons, William Edward and Alfred Vincent, joined the business. Mr. Newton married Miss Eliza Sophia Coulson, of Exeter, who survives him. He leaves no children. His death, which occurred at the offices of the firm, 6, Bream's-buildings, was sudden. He was occupied with his ordinary work all day, and died ten minutes after being taken ill from heart failure. Though known to have a weak heart no dangerous symptoms had previously been noticed.

GENERAL NOTES.

Reafforestation in Cyprus.—From the first occupation of Cyprus by Great Britain, the preservation of the forests of the island, and reafforestation, have been recognised as primary and pressing duties. Unfortunately, the tribute of £92,500 payable to Turkey has left no money in the Treasury for this necessary work, and a simple and economical policy of protection and preservation was all that was possible. The result of twenty-seven years of this policy is visible, says Sir C. A. King-Harman, in his report upon the island (C. 2796), in the partial recovery of those portions of the forest where Nature, under the protection of the Government, has been able to re-establish a certain number of young trees. "Those parts of the ancient forests where reproduction has been going on, and where the Government has excluded the goats, checked the fires, and limited the fellings, are promising and pleasant to see, but the far larger areas, where either the old trees are unprotected, or where seedlings perish annually in millions from exposure, are a lamentable spectacle to all who are interested in the future of Cyprus, and who recognise that the gradual denudation of her mountains is surely imperilling the future." The Government of Cyprus has done its utmost with the very limited means at its disposal, but the most that can be said is that the ruin and destruction of the forests have been arrested, and that in certain areas, small in proportion to the whole extent of the forests, reproduction is progressing in a satisfactory manner. For the reafforestation of the larger areas expenditure is necessary, of which there is no immediate likelihood.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

December 20.—"The Aerograph Method of Distributing Colour." By Charles L. Burdick. Carmichael Thomas, Treasurer of the Society, in the chair.

Papers for meetings after Christmas:—

"London Traffic." By Captain G. S. C. Swinton (L.C.C.).

"The Preparation of Oxygen from Liquid Air." By Monsieur Raoul Pictet.

"Submarine Signalling." By J. B. MILLET.

"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"The Planting of Waste Lands for Profit." By DR. J. NISBET.

"Industrial Russia." By LUCIEN WOLF.

"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON.

"The Artistic in Painting and Photography." By J. C. DOLLMAN, R.I.

"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E.

"Motor Boats." By BERNARD B. REDWOOD, B.A.

"The Scientific Aspects of Voice Development." By WILLIAM A. AIKIN, M.D.

"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT.

"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE.

"The Fisheries of the North Sea." By WALTER GARSTANG, M.A.

"The Garden City and the Cheap Cottage." By THOMAS ADAMS.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. A. FLEMING, D.Sc., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (In continuation of previous courses on "Electric Oscillations and Electric Waves," and on "Hertzian Wave Telegraphy.") Four Lectures.

LECTURE IV.—DECEMBER 18.—*Measurement of Free and Stationary Wave-Length.*— Stationary waves on wires—Velocity of propagation—Mechanical model—Loops and nodes of potential and current — Special qualities of spirals — Methods of detecting loops and nodes—Radiation from aërial wires—Velocity of free waves—Relations of free-wave lengths to antenna length—Direct and inductively coupled aërials—Determination of the wave-length and damping of the waves radiated from antennæ—Methods of syntonising coupled circuits with the Cymometer.

HOWARD LECTURES.

A Course of Three Lectures will be given under the Howard Trust, by PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., on "High Speed Electric Generators, with special reference to driving by Steam-turbines," on the following Thursday Evenings, at 8 o'clock :—January 18th and 25th, and February 1st.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. J. A. Fleming, "The Measurement of High Frequency Currents and Electric Waves." (Lecture IV.)

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Messrs. A. Gascoyne and A. J. Dix, "Stained Glass."

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m.

Sociological, School of Economics, Clare Market, W.C., 8 p.m. M. Waxweler, "The Institut de Sociologie: Its Equipment and Work."

Alpine Club, 23, Savile-row, W., 8½ p.m.

TUESDAY, DEC. 19...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Henry Alexander Mavor, "Heat-Economy in Factories."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. 1. Dr. Arthur Newsholme and Dr. T. H. C. Stevenson, "The Decline of Human Fertility in the United Kingdom and other Countries as shown by Corrected Birth-rates." 2. Mr. G. Udny Yule "Changes in the Marriage and Birth-rates in England and Wales during the Past Half-Century, with an Inquiry as to their Probable Causes."

Pathological, 20, Hanover-square, W., 8½ p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Drill Hall, James-street, Victoria-street, S.W., 3 p.m.

WEDNESDAY, DEC. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Charles L. Burdick, "The Aerograph Method of Distributing Colour."

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. George C. Simpson, "Kite Observations from a Trawler in the North Sea." 2. Messrs. C. J. P. Cave and W. H. Dines, "Investigation of the Upper Air in the West Indies by means of Kites." 3. Mr. W. H. Dines, "Temperature Observations during the partial Solar Eclipse, August 30th, 1905." 4. Mr. J. R. Sutton, "Comparison between Glaisher's Factors and Ferrel's Psychrometric Formula." 5. Dr. John Ball, "A Rapid Method of finding the Elastic Force of Aqueous Vapour, &c., from Dry and Wet Bulb Thermometer Readings."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. D. M. S. Watson, "A 'Fern' Fructification from the Lower Coal Measures of Shore, Lancashire."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, DEC. 21...Linnean, Burlington-house, W., 8 p.m. 1. Dr. A. B. Rendle, "Report on the Vienna Botanical Congress." 2. Dr. Franz Kranzlin, "Cyrtandraceæ malaganæ novæ." 3. Mr. H. J. Groves, "Charcæ from the Cape collected by Major A. H. Wolley-Dod." 4. Mr. B. Daydon Jackson, "Note on the Distribution of *Shortia*, Torr. Gray."

Chemical, Burlington-house, W., 8 p.m. 1. Messrs. J. B. Cohen and I. H. Zortman, "The Relation of Position Isomerism to Optical Activity, Part V. The Rotation of the Menthyl Esters of the Isomeric Dibromobenzoic Acids." 2. Messrs. J. T. Hewitt and H. V. Mitchell, "Azo-derivatives from *a*-naptho-methylcoumarin." 3. Messrs. A. W. Crossley and N. Renouf, "The Supposed Identity of Dihydrolaurolene and of Dihydro-isolaurolene with 1:1-dimethylhexahydrobenzine." 4. Mr. N. Smith, "The Slow Combustion of Carbon Disulphide."

Numismatic, 22, Albemarle-street, W., 7 p.m.

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FRIDAY, DECEMBER 22, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, at 7 o'clock, by PROFESSOR HERBERT JACKSON, F.I.C., on "Combustion and Flame."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

CANTOR LECTURES.

Dr. J. A. FLEMING, F.R.S., delivered the fourth and last lecture of his course on "The Measurement of High Frequency Currents and Electric Waves," on Monday evening, 18th inst.

A vote of thanks to the lecturer for his valuable course of lectures was passed on the motion of the Chairman.

The first lecture will be published in the next number of the *Journal*.

NORTH LONDON EXHIBITION TRUST.

In 1865, the Committee of the North London Working-classes and Industrial Exhibition (1864), presented to the Society of Arts a sum of £157, the balance of the surplus from that Exhibition, with a view to the award annually of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art Workmanship Competitions were discontinued after 1870, but since that date various prizes have been awarded under this Trust. Since 1902 prizes have been offered to the students of the Artistic Crafts Department of the Northampton Institute, Clerkenwell, and those offered for the session 1904-5 have been awarded as follows:—

First Prize ..	£7	7	0	.. L. E. Stanton.
Second Prize	£4	4	0	.. A. Holm.
Third Prize ..	£3	3	0	.. Divided between H. J. Rowley and W. Gilbert.

REPORT ON LEATHER FOR BOOK-BINDING.

The enlarged and illustrated edition of the Report of the Committee on Leather for Bookbinding is now ready. It is published by Messrs. George Bell and Sons, of York-house, Portugal-street, W.C., at the net price of 10s. 6d. Members of the Society requiring a copy can obtain one, at a discount of 25 per cent., by applying direct to the Secretary of the Society.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday evening, December 12; Sir Marcus Samuel, Bart., Vice-President of the Society, in the chair.

The paper read was—

HISTORICAL PAGEANTS.

By Louis N. Parker, F.R.A.M.

I fear that possibly you are to be the victims of a disappointment to-night. You are so accustomed in this room to learned disquisitions by masters of their subjects that the homely talk of an ignorant person must seem to you very jejune and uncalled for. It was not until I had accepted the invitation to address you on Historical Pageantry that I realised I knew nothing whatever of the subject, or, at any rate, that such knowledge as I possess is only superficial and desultory. I found as I began to prepare my paper that I should have to depart almost entirely from the title of it, and, instead of giving you a well-thought-out account of what used to be done in pageantry in ancient times, confine myself to a description of what I did myself last summer at Sherborne, of what I hope to do next year at Warwick, and of what I dream of doing, if all goes well, in the not remote future. I only beg you not to think I am speaking egotistically. My apology is that I can only hope to be of any use to you if you will allow me to speak of a matter of which I myself have a slight experience, and in which I am profoundly interested.

As a matter of fact, the historical side of the subject was most ably treated here in 1902 by Miss May Morris. You know from her very interesting paper more about masques and triumphs and pageants than I could hope to tell you. I would not, if I could, go over the ground she has tilled so well, and I am all the more at liberty to speak of the effort I personally am making because you are familiar with the history of the matter.

I take it for granted that there are very few things with which this audience is not familiar. But has it ever occurred to you how ignorant the majority of people are about their own immediate surroundings? I venture to say that if you were to ask the first man you met in John-street why this is called the Adelphi, he would not only not know but he would not care. Why, only the other day, somebody or other suggested that the name of the Haymarket should be changed because it was senseless and conveyed no meaning!

So we move about London with names full of great historical meaning in our mouths—names which are in themselves poems and romances—and we think nothing of them. Perhaps it is as well we don't, for if we stopped to do so we should infallibly get ourselves run over.

But as it is in London so is it also in every town in England. In each of them there is a small handful of men who value the town's treasures, who are steeped in its history and its traditions, but, beyond that handful, the vast majority of the inhabitants never let these matters bother them. Until quite recently the ancient buildings in a town were considered unsightly nuisances, to be swept away, just as the magnificent old furniture of our forefathers was consigned to the lumber room. I could sit down and cry when I think of the lovely and venerable things the first half of the nineteenth century sent to limbo. I could cry when I think how the clergy were let loose in the land to play havoc among the lovely and venerable churches in their charge. I could cry when I think of the lovely old houses, old manor houses, moated granges, timbered mansions, ruthlessly torn down to make room for this desirable residence and those commodious premises. Think of what Park-lane was, and realise what it is. Think of the High-street, Kensington, of no more than ten years ago, and see it now. When you find yourself in some quiet country town which went to sleep when the stage coaches died and has not yet been disturbed by motors, and amidst Queen Anne mansions, Elizabethan mansions, stately Georgian mansions, half-timbered mansions, you are suddenly confronted with the latest steel-frame six or seven storied Emporium, the basement of which is all plate-glass and ginger-bread, covered with horrible advertisements of monstrous comestibles, quack nostrums, foods for the fat, pale pills for pink people, all labelled with hideous outrages on the English language in the shape of new words—clenol for a soap, quicklite for a match, ritefast for an ink—you do realise that here is a ghastly thing which kills and murders the beauties of its surroundings; which ought to be torn down, burnt, trodden under foot. Yes, you realise it, but the inhabitants of the town in which it stands do

not. They are proud of it, for it is a symptom that their town is moving with the times. They feel that London has no longer the monopoly of great establishments.

But what, you ask, what can all this have to do with pageantry? Why, it has everything to do with it. This is just precisely the kind of spirit which a properly organised and properly conducted pageant is designed to kill. This modernising spirit, which destroys all loveliness and has no loveliness of its own to put in its place, is the negation of poetry, the negation of romance. Yet human nature is the same throughout all ages, and in our hidden hearts, we have as much poetry in us as our forebears, and as much love of romance, only we are ashamed to say so. We have been shamed out of saying so, or out of showing any such feeling, by long years of repression, by long years under the tyranny of the genteel, and under the thraldom of push and advertisement. If you want art, beauty, grace, whatever word you choose with which to describe the quality—if you want this indescribable thing to touch the man to-day—to come into relation with his personality, to have some share in his life, to colour his thoughts, to influence his actions, you can only get at him through his eyes, or by dragging him, willynilly, into the vortex of an artistic experience.

Now then, take that man by the button-hole, and say, "Come out of your office, come away from your desk, or from your counting-house, and be King Alfred! Be Charlemagne! Be William the Conqueror! Put on armour, get on a horse: come and be a Danish chieftain. Enact the very deeds that were done in your ancient town five hundred or a thousand years ago." Well, he leaps at the idea. Here is a bit of fun. But before he knows where he is, he is taking the fun in grim earnest. He begins to understand. He begins to realize that the vague names he has associated with vague dates, are the names of living men and women with like passions to his own. He realizes for the first time that their deeds which had hitherto only struck his senses dully as pages of history, were done as the unconscious development of their lives; that, in short, they were doing what he is doing every day—just living. Further, he begins to grasp that, because they did such and such things in the old days, he is able to go about his own business to-day without let or hindrance. Then comes the sudden revelation that these portentous things were done in his town, in his Abbey Church, in his street—perhaps in the very house he is now living in. At once, the town and its buildings and monuments are transfigured in his eyes. Woe betide the iconoclast who thereafter dare lay sacrilegious hands on one stone! Local patriotism has been aroused, and out of local patriotism, I think, springs a far finer national patriotism than any founded merely on rifle-clubs and Morris tubes. Let those be an outcome of patriotism if you like, but get your patriotism first. Let your young citizens clearly understand what they are defending, and they will defend it with a higher courage than if they are merely to fight the foreigner because he is foreign. Further, your performer acquires quite a new idea of beauty. He sees himself a figure in a striking picture, and he realizes that pictures themselves may possibly have some practical relation to real life. He acquires further an interest in all manner of remote subjects which had previously been hidden secrets for him, or which he had laughed at as ridiculous and meaningless survivals. Heraldry, for instance. He knows now why a bear is the badge of a certain family: he has seen the ancestor win the badge by his personal prowess, or perhaps he has enacted that very ancestor. Costume, again, receives quite a new importance, when you have had to devise it and wear it and be responsible for its correctness.

So much for the individual, then. And as for the individual, so for the town. For months the whole town is set to work; all the men and women who can do anything have been laboriously hunted out and set to work upon whatever they can do best. The broad principle is laid down and firmly maintained that whatever can, anyhow, be made in the town itself, shall not be sought for outside. Now to judge by my very short experience, it is quite amazing how mnch talent and technical skill is lying dormant and unsuspected in the provincial towns of England. Both at Sherborne and Warwick the inherent requirements of the pageant set quite difficult problems in the way of elaborate properties and costumes. Problems so difficult that I was secretly prepared to own to defeat, and at the last moment to call in the professional assistance of a London property-master and costumier. Fortunately I held my tongue, and in both towns the right people have arisen ready and qualified to cope with far greater difficulties than any I am likely to suggest. At Sherborne a rough-hewn stone altar of

gigantic size, which should be capable of being carved into the likeness of a cross with theatrical quickness yet with sufficient verisimilitude to avoid being ridiculous, was provided with smiling ease. So was a very handsome and gorgeous litter for a Saxon queen; so was, amongst other things, a beautiful copy of a triptych of the Van Eyck school, the original of which is in the Almshouse. At Warwick, the monstrous and terror-compelling head of the famous Dun Cow seemed to present difficulties, as did Queen Elizabeth's travelling-coach, and her great gilded barge; but no sooner were these difficulties mentioned than artificers arose ready to grapple with them, and, if I may trust the designs, they are already sure of success. In both towns, every costume, every property, was and will be designed and made on the spot, with the exception of heavy plate-armour and wigs. You can see how greatly that adds to the interest the town takes in the undertaking. You can also see how greatly it adds to the pageant as an educating force, and as a means of bringing different strata of society together. At Sherborne and Warwick some 250 ladies were or are occupied in designing and executing the costumes. They meet once or twice a week, in working parties of twelve or twenty, at each other's houses—and, mark me, they know they mustn't quarrel until the pageant is over, by which time they will have grown such good friends that quarrelling will be out of the question.

And all this time I have not told you what precisely I mean by a pageant. Here let me read an extract from my introductory speech at Warwick:—

"Let me say here what a pageant is *not*. It is not a circus. It is not a procession. It is not in any sense a display of professionalism. Nor is it a pastoral play. What is it, then? It is the representation of the history of a town, in dramatic form, from the earliest period to some later point, forming a fitting climax. This is set forth in verse and prose of the most direct sort, and is embellished with choruses, songs, dances, marches, and every legitimate spectacular adjunct. It is acted in some beautiful and historical spot, which is left without any artificial embellishment whatever. It is acted by the citizens of the town themselves, their wives, their children, and their friends. It is, therefore, acted by the actual lineal descendants of the characters represented. It is acted in a spirit of simplicity and reverence, and the audience must bring the same spirit in watching its progress. It is not a stage play. It is a lofty and dignified panorama of the town's history. And it is more. It is an act of local patriotism. And out of local patriotism grows that wider patriotism which binds the sons of England together—whether they call themselves New Zealanders, Australians, Canadians, or Americans. But it is more still. I confess I cannot conceive a pageant except as an incident in a great act of praise and thanksgiving. I would have all pageant days begin, as a matter of course, with joyful festival services in all the places of worship in the town—or, rather, these festival days should close with a pageant. This was the origin of pageants in the old days, and when this idea was lost sight of the pageant withered and died, as it deserved to. I should be ashamed of the praise which has been too generously lavished on me for reviving this ancient custom if I did not know in my own heart that I had a higher object in view even than the invention of what to all intents and purposes is a new form of drama."

Now, briefly, as to the technical means whereby a pageant may be built up. It needs, first, a narrative chorus of men's voices only, which fulfils a purpose analogous to that of the chorus in the Greek drama. The arena in which the performance takes place is very large. At Sherborne it covered seven acres; at Warwick the distances will be even greater. The performers will enter through woodland glades many hundred yards away; they will even come up the Avon in barges, and they will be seen on the remote slopes of the park on the other side of the river long before and long after they appear on the actual arena. Nevertheless, the audience must know who they are and what they are going to do. The function of the narrative chorus is to impart this information. Next, we want an unlimited crowd. The crowd is the characteristic and astonishing part of a pageant, and its size and life-like movements contribute mainly to its success. It may at first sight seem difficult to make a really large crowd of amateurs act, but I assure you it is the easiest thing in the world. It is difficult to make professional supers act, because they have a conventional idea of what is wanted, and they express all passions by rudimentary symbols. But get a real crowd, and once make them understand they have to express real emotions as they would in real life, and the effects are astonishing, not to say terrifying.

Lastly, we want a very large supply of actors. In the Sherborne pageant there were over ninety speaking parts. In the Warwick pageant there will be close on two hundred. Now you may think that, however roughly effective a large crowd taken in the rough may be, when it comes to individuals and their utter inexperience in the art of

acting the result must be ridiculous. I assure you it is not. Of course, you must choose your performers with some consideration for the personages they are to represent. But if physically they are in keeping with their parts, and if they speak distinctly, the result is absolutely satisfactory. In some instances it is a great deal more. I could mention certain impersonations in the Sherborne pageant, both male and female, which could not have been bettered under any circumstances. I am not going to mention them, because that would be most unjust to the others who did their best, and were quite good enough for all practical purposes. You see, first of all, your performers must be in earnest, next, they must be simple, and lastly, they must be humble. Granting those three attributes, whatever else they are, they cannot be ridiculous. Moreover, the open air transfigures everything, it makes every gesture seem natural and unforced, and it increases the illusion indescribably.

It is, of course, an essential, that not a trace of the mechanism by which the crowds are controlled, should be visible, nor any sign of the subsidiary helps. The audience must see nothing whatever of the orchestra, they must not catch a glimpse of the conductor, the existence of a Master of the Pageant must not be remotely indicated. When our audiences have found their seats, they have in front of them nothing but the arena on which the pageant is to take place, and that is absolutely as nature made it, without the slightest artificial enhancement of any sort, and without the suggestion of any living thing within a hnndred miles of it, beyond beasts and birds, although a thousand people are eagerly waiting for their cue within a few yards. Also, when the pageant is over, and the last actor has disappeared from the arena, the audience's final glimpse of it is again as of a landscape void of any living thing save birds and beasts. The performers have all melted away as in a dream.

With your permission I will now show you a few pictures from the Sherborne pageant. I am indebted for the loan of the slides to the kindness of Canon Westcott, headmaster of Sherborne School, whose wonderful enthusiasm did so much for the Sherborne pageant, and whose own performance in it was an exquisitely beautiful thing. The living pictures are due to the courtesy of the well-known Urbanora Company.

Before I conclude I should like, if I may detain you a few moments, to sum up what I have already told you, and to disclose to you a scheme—I had better say a dream—I am cherishing.

I hope I have made it clear that I have a very lofty ideal of what a pageant should be, and of the end it may be made to serve. You may have noticed that I have not said a word on the financial side of the question. That ought not really to come into consideration at all A town determined to do itself honour and to claim the attention of the world by celebrating its history and the fame of its great citizens ought by no means to count the cost. Unfortunately the cost has to be counted in this imperfect world and it is, therefore, comforting to be able to say that at present, and for the next few years, until pageants have become cheapened and vulgarised, they are a pretty safe investment. But I have very little interest in that side of the matter. Even if a pageant were a dead loss, I say the gain to any town giving it would be incalculable; the gain in added brightness, in re-awakened civic pride, in increased self respect. I believe I have—rather late in life, alas!—discovered the means whereby I, too, may add my mite towards bringing rural life in England back to its old-time innocent gaiety while reviving research into local history, pride in the great men who have distinguished that history, and, in short, the noblest sort of patriotism. I am quite unfeignedly proud of that; I may say I am getting conceited about it. It is no mean thing to have forced my friend James Rhoades to write such beautiful poems as "Fons Limpidus" and the "Triumph Song" in the Sherborne pageant, and the fine things he is writing for Warwick, and to have given thirty thousand people the privilege of hearing them. It is no mean thing to have given these young composers of Sherborne and Warwick an opportunity of showing of what musical stuff they are made before the same enormous audiences. Well, but I want to do more. I want to be able to look forward to a great National Pageant. It is not an idle nor an impossible dream. Next year two towns will have had the celebrations. I am already invited to conduct two pageants in 1907. In 1908 Sherborne is to be repeated, and there will very likely be a new one. I am hoping for another in 1909. Then we shall have had five great pageants in five separate historical towns. We shall have accumulated an enormous number of very beautiful and very costly dresses, and a large quantity of curious and interesting properties,

We shall have drilled two or three thousand people to act together. We shall have masses of music with skilled singers familiar with it. Now, then, how easy it will be to select the two finest episodes out of each pageant, choosing them with a view to historical continuity, to add here and there one or two new points, so as to complete the thing and make it coherent. After separate rehearsals (very few) in each town, we will bring the whole thing up to, let us say, Windsor-park, and perform it two or three times, with three thousand performers, for the benefit of some great national fund, before audiences of 50,000 at a time. Every performer will, I think, gladly give his own services entirely gratis. I know the Master of the Pageant would do so. And we will call it the Pageant of England.

This is the scheme which I hope to live to see brought to a happy conclusion. This is the scheme also which would be greatly furthered by a word of encouragement from the Society of Arts.

DISCUSSION.

The CHAIRMAN thought that all present would agree with him that they had listened to a most instructive and entertaining paper. They would not be surprised, having seen through the slides exhibited on the screen the energy with which Mr. Parker had conducted the undertaking, that he had been able to fill those whom he had had under his *bâton* with enthusiasm. Mr. Parker in that respect was probably exceptional, and he was afraid it would he impossible to find many such as he to organise and conduct similar pageants. In London such pageants were almost necessarily confined to that which was known as the Lord Mayor's show, neither the surroundings nor the possibilities enabling those who carried out that show to emulate the beauties or the historic interest which had been so vividly displayed in the paper. He was quite sure every one was in perfect sympathy with Mr. Parker, and wished him the greatest possible success in the dream which he cherished. He was certain, as Mr. Parker had rightly said, that the influence of such pageants was elevating in its character, and that no harm could possibly be done; and he therefore would be very glad indeed, if it were at all possible, to see such a series of pageants of historic events, in suitable centres, as the author had so vividly described, not only in the paper, but by means of lantern slides and the cinematograph.

Mr. IMRE KIRALFY, after heartily congratulating Mr. Parker on the magnificent work he had done, said he was sure that if he further continued his labours the dream he had mentioned would be fully realised. He himself had had some experience in spectacular pageants, and some years ago adopted a similar system to that used by Dr. Parker, which was certainly the right and only system by which a large number of people could be conducted in a perfect manner, and congratulated Mr. Parker on having discovered the system several thousand miles away from the spot where he (Mr. Kiralfy) carried out a similar work. He was quite sure it would be impossible for anybody to surpass in details, in historical correctness, and in any other way the pageant which Mr. Parker had so beautifully carried out, and he again cordially congratulated Mr. Parker on the success he had achieved.

Mr. LEWIS DAY said that he was a rather frequent attendant at the lectures given at the Society of Arts, and the paper he had just heard was the brightest, breeziest, freshest, and most enthusiastic it had been his pleasure to listen to in those rooms. He came to the meeting without any very great faith in the possibilities of pageants in England in these days, believing that we had become a rather prosaic people; but he confessed that Mr. Louis Parker had almost persuaded him to believe that Englishmen were possibly poetical—at all events, Mr. Parker had shown that some were. Judging from Mr. Parker's more than admirable paper, and the very remarkable pictures which had been shown, he was quite sure that if it was possible to realise in any way the dream of a great national pageant, Mr. Parker was the man to do it, and, as far as he knew, the only man. He hoped some day it would actually be realised.

Mr. MATTHEW WEBB said he had been very much struck with the most agreeable and very practical manner in which people could be taught history by means of the pageants described by Mr. Parker. Such pageants delightfully carried the minds of townsmen and villagers back to their own early history, and created in them a much greater interest than most people in the country took in such matters. There was one remark made in the paper with which he did not agree, namely, that London could not do something of the same kind. Some of those present remembered the Masque at the Guildhall with some degree of admiration, and he hoped Sherborne would find that London would turn its mind to something of the kind, and be able to arrange for a pageant worthy of the greatest city in the world.

Mr. H. B. WHEATLEY said that many present would remember Miss May Morris's very interesting paper on Pageantry and the Masque, read

on June 2, 1902, to which Mr. Parker had referred. Miss Morris dealt largely with what had been done in London in the past. He hoped that there might be some revival of these beautiful displays in the future. The Corporation of London had two great difficulties in reproducing pageants in the City. In the first place, Lord Mayor's day fell at a time of year — November, when it was by no means pleasant to stand in the streets to watch pageants. Again, it would be almost impossible in London to find positions, such as those utilised at Sherborne, where the pageants could be carried on; but at the same time, although he thought it would be impossible to have in London anything like the pageantry that Mr. Parker had shown, he did think that some of the older pageantry, which was so distinguished a characteristic of the history of London, might be revived. Of course, a pageant in London would have to be a procession, to a certain extent, and he thought it would be quite possible for such a procession to stop at various points in the wards of the Lord Mayor or the Aldermen, and for speeches to be made there, as was done in the earlier history of London. Moreover, the great river of London was always with them, and surely that might be utilised as it was in the past, when the barges of the City Companies, in all their bravery, floated on the Thames and enlivened the animated scene with colour and beauty. The Chairman possessed great influence in the City of London, and he hoped that Sir Marcus Samuel might find it was possible to do something in the matter. He was sure that a truly artistic pageant in London would give great delight to all true Londoners. The materials were all ready to hand, and with a certain adaptation to the exigencies of modern life, he was certain could be made a great success.

The CHAIRMAN said the fact that the Society of Arts had gladly welcomed Mr. Parker, was a response to the appeal he had made that they should show their sympathy with the object he had in view. He could assure Mr. Parker that the invitation had been very readily extended to him, while it was a pleasure to him personally to be present and express that sentiment on behalf of the Society. He was convinced that everyone present would cordially support a vote of thanks to Mr. Parker, while thanks were also due to the Rev. Canon Westcott, Head Master of Sherborne School, for the loan of lantern slides of the Sherborne pageant, and to Mr. Charles Urban, of the Urbanora Company, for the exhibition of the moving pictures of the pageant in the cinematograph, while both exhibits had undoubtedly added greatly to the enjoyment of the evening.

The resolutions of thanks having been carried unanimously, the meeting terminated.

SIXTH ORDINARY MEETING.

Wednesday, December 20th, 1905; CARMICHAEL THOMAS, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Arkell-Hardwick, Alfred, Arkell, Muswell-hill, N.
Craggs, Henry Foxton, J.P., 156, West-hill, Putney, S.W.
Lillie, George Ernest, Bhavnagar Para, Kathiawar, India.
Sparling, Augustus Henry, Aligarh, United Provinces, India.
Suares, Felix, Messrs. Suares Frères et Cie, Cairo, Egypt.

The following candidates were balloted for and duly elected members of the Society:—

Almond, Richard Pengelly, Balderton-house, Balderton, Notts.
Ballantine, James B., The Edison Ore-Milling Syndicate, Richmond, Surrey.
Barcroft, D. M., Croxteth, Baldoyle, Co. Dublin.
Bhore, John, Assoc.M.Inst.C.E., care of Messrs. Coutts and Co., 440, Strand, W.C.
Brown, George Gordon, 14, Beulah-hill, Upper Norwood, S.E.
Burford, Miss Evelyn Edith, care of Sir Boverton Redwood, 4, Bishopsgate-street Within, E.C.
De Nordwall, Charles F. 2, Observatory-gardens, Campden-hill-road, W.
Ellis, Clement Campbell, 82, Lancaster-gate, W.
Howard, Engineer-Captain George, Cantiere Odero, Sestri Ponente, Genoa, Italy.
Parrott, Joseph, 3 Wellington-street, Stockton-on-Tees.
Picard, John, 9, Vicarage-gate, Kensington, W.
Whitehead, Thomas, Brindle-lodge, near Preston.

The paper read was—

THE AEROGRAPH METHOD OF DISTRIBUTING COLOUR.

By CHARLES L. BURDICK.

I had the pleasure of reading a paper before this Society in 1894, at the time when I was introducing to the public my invention, the Aerograph, or Fountain Air-Brush as we called it then. I feel much honoured that I am again invited to read to you, and report what progress has been made after these eleven years. I have the more pleasure as I am able to describe to you two important developments of this method of distributing colour by compressed air, which are just arriving at the finished

stage, after several years spent in the work of experimental development.

I will not weary you with a description of the Aerograph, which is now pretty generally known, and which was described in my former paper. I will, however, before finishing, give you a practical demonstration by doing a drawing or sketch for the benefit of those who may not have seen it working.

I should like to say that the instrument has gone through several changes since it was first introduced, and patents have been taken out for several important improvements; and changes made to adapt it to the work it has found to do. In its commercial development it has followed the lines of least resistance, as would be natural. In those arts where precedent and sometimes prejudice are strong it has made slow progress, and in those arts where commercial competition is keen it has found easy victories.

As an illustration, it has not been generally adopted in the schools, where I am convinced it would be extremely useful; but for the decoration of pottery it has come to be a standard requirement.

It is not easy to demonstrate that a youth might learn to draw with the aerograph in one-half of the time that he could with pencil or brush; the inertia of masters would have to be overcome to secure its acceptance. But if a vase, or cup and saucer, can be done at one shilling that formerly cost two, all prejudice stands aside. It is not a crying matter, wanting immediate attention, if a youth loses a year of his life in futile endeavour, but a shilling is a tangible quantity to a manufacturer, and will be looked after.

For the decoration of pottery the aerograph is now being used in the Government factories of France, Germany, and Denmark, and some very beautiful work is being done with it, particularly at the Charlottenberg and Copenhagen factories. We are even sending installations of the aerograph to the potteries in far off Japan.

The facility with which the colour can be distributed on the biscuit ware has had a tendency to develop commercially the under glaze work, which is both more beautiful and more durable than over glaze decoration. In ground laying and stencilling the colours distributed with the aerograph have more softness and greater brilliancy than when applied by the older methods.

The aerograph has met with a large measure of success in water-colour drawing and in photographic portrait work. In the preparation of the pictures for process engraving it has had much to do with the success of that method of reproduction, as the preparation of the picture determines in a very large measure the result which the printing will show. We shall be able to-night to show those interested some specimens of this work. Even the details in pictures of elaborate machinery are shaded with the aerograph, a considerable portion being done by means of masking, which to the uninitiated would seem a slow process, but is both quicker and better than work done with an ordinary brush.

I shall not have time to detail all the various applications of the aerograph, which range from painting miniatures to painting battleships. But perhaps one of the most considerable developments which has grown out of the spraying of colours by compressed air is its application to decorative stencilling.

As you are doubtless aware, stencilling has been done for hundreds of years with a dabber or short brush, which is squared at the end, and the colour is delivered by short strokes from the end of the brush, a process slow and laborious; with the aerograph the colour is blown directly through the stencil in a space of time which is but little longer than is required for pointing the instrument at the opening in the stencil. But this saving of time is not the only advantage in stencilling; with the dabber only very crude and imperfect gradations of colour, or the blending of two or more colours, are possible, while with the aerograph perfect gradations and perfect blendings are obtainable; two primary colours may be blended so perfectly as to give very pure secondary tints where one colour is distributed over the other.

This improvement in stencilling has found its application in many arts beside pottery. Decorating silk and other fabrics with the aerograph has grown to be a considerable industry, principally in France, where it is also largely used for colouring feathers and artificial flowers.

Decorating walls and wall coverings is a developing industry, and there are others I might mention, but perhaps the most unexpected has been the progress of the aerograph into the departments of the printer. I do not refer now to the use of the aerograph for the preparation of pictures for process, but to its application to decorative printing, as, Christmas cards, post cards, window tickets, and the like, where lithographic work has formerly been chiefly employed. It is true that it has

found access only in the departments where limited editions are required, but there is more to follow. First, I should like to point out some of the reasons why it is commercially possible for the aerograph to compete with lithographic work. The primary cause is that the aerograph can make more perfect gradations of tint, going at once from a deeper shade to a tint so light that the eye cannot distinguish its termination, doing in one operation what would require several printings in lithography. I will illustrate this with a diagram—

Fig. 1.

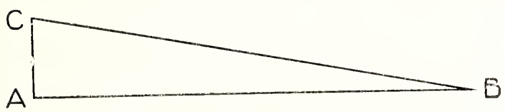
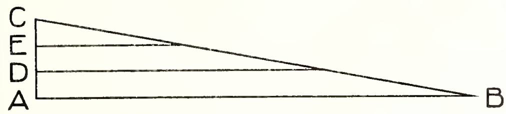


Fig. 2.



If the lines A B (Figs. 1 and 2) represented a surface on which colour is to be graduated, and the lines, A C, represented the depth of shadow or colouring at its deepest part, the lines C B (in Fig. 1) will show the gradation possible by one operation with the aerograph, and the dividing lines in Fig. 2 will give you an idea of what is required in lithographic work, viz., one printing A D, a second printing D E, and a third printing E C, making in all three printings to produce the gradation of colour which, by the aerograph, is produced in one operation.

Another point which favours the aerograph, is the initial cost of the work; the difference lying between elaborate stippling on stone or zinc, and the cost of a simple mask, or stencil. To put this into figures, I will take a simple case of, say a 10 in. by 8 in. shaded card for a window ticket, assuming that the manufacturer has an order for 1,000 of them. It might require, in a simple design, the careful stippling of three litho stones at an expense, say of 15s. each, or 45s., then there would be three printings necessary, say 2s. 6d. each —7s. 6d. Take the case of the aerograph work; three stencils—say 5s. each—15s., four days labour (the work is usually done by girls), 12s. Total cost of printing by litho, £2 12s. 6d.; with the aerograph, 27s. These figures vary continually, as the conditions vary with the character of the work and the size of the edition—sometimes more favourable to the aerograph, and sometimes more favourable to the litho printer.

Heretofore this work has been done with the aerograph, one piece at a time; and you will note that in my comparative figures the cost of the actual printing only is higher for the aerograph than for the litho printing. To meet this I have invented a machine for doing this work automatically. Briefly described, it is a printing machine where stencils are used in place of type, and sprays in place of inking rollers.

Now, I shall not weary you with a long description, as we have the machine here tonight, and will be able to show it in operation, but I will say that the card or paper is put under clips by the operator, as in an ordinary printing machine, and is automatically fed through in accurate register, coloured, and deposited in a box, the speed being about the same as for litho printing—1,200 to 1,500 per hour.

I know that you will not care for a lot of detail as to how this is done, a description of wheels and cams and levers is not very inspiring, but you may be interested in a brief description of the method of development by which the invention was arrived at, and the difficulties met and overcome.

I may say that the invention had its inception in the idea of facilitating the handling of cards and stencil: a simple device for lifting the stencil by the foot, so that the operator who was using an aerograph with the right hand would have the left hand free to remove the card operated upon, and the stencil would be brought into position by the foot by means of a lever and connections.

From that it was a short step to designing a machine which would carry the card or paper under the stencil and then deliver it to a box.

The chief difficulty experienced here was securing an accurate register and arranging the automatic clips to take up and release the cards at the proper moment. But the mania for improving things would not let me rest with that, so I put automatic sprays above the stencil, with the result that greater speed and accuracy were acquired. But here one of the difficulties but dimly foreseen became serious, the rapidity of the spraying operation caused an accumulation of colour on the stencil and blotted the work at the edges of the openings. The first attempt to meet this was by warming

the stencil to cause more rapid evaporation; this was only partially successful, and was superseded by a system of sucking the surplus colour from the stencil by means of exhaust air, with what success we shall be able to show you in our practical demonstration to-night.

Like all things under the sun, this machine has, along with certain advantages, definite limitations, and I have no doubt my hearers will want to know something of the latter. In the first place let me say we do not attempt letter-press printing.

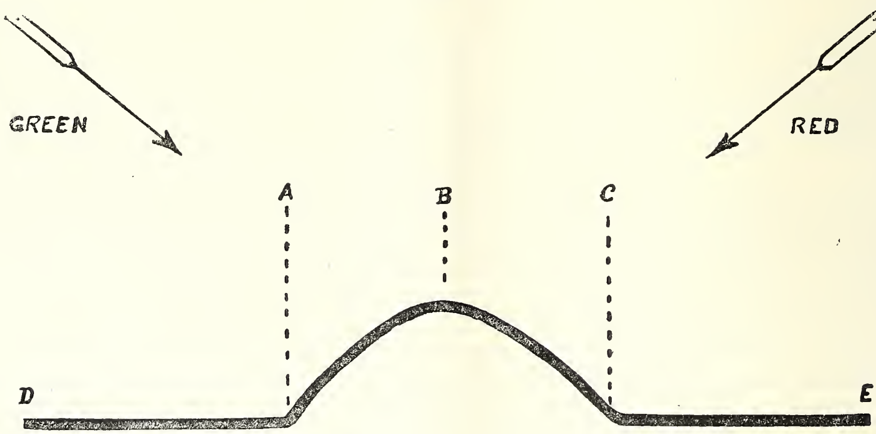
Its application is limited to colouring and decorative printing. We anticipate that it will be extremely useful for colouring designs, photographs, and pictures generally, where nice gradations of colour are wanted.

In the colouring of photographs very transparent colours may be used, to retain the maximum of the light and shade of the photograph. As the colour is deposited in a fine stipple, additional transparency is obtained. Glossy-surface pictures which would be ruined by contact printing, retain their surface when suitable colours are sprayed on by this method. Several colours may be applied at one operation, and one super-imposed upon the other or blended with it, an operation which is not possible in any simple form of printing machine. This means, for instance, a sunset-sky in a picture could be graduated from pale blue to yellow red in a single operation, and the foreground of the picture might be coloured, say brown, at the same time, provided the details to be coloured, in the foreground, did not come in juxtaposition with the sky.

I have described, and am showing you to-night, a machine with a single stencil and two colours only, but I have designed a machine for a number of stencils which will permit a large number of colourings to be done at one operation, the card being automatically carried from one stencil to another.

I should like to refer here to a unique decorative colour effect which has been developed as a result of the use of the aerograph, and which this machine is especially suited to produce. I refer to the colouring of opposite sides of a figure or embossed surface, the result is to heighten the effect of relief, and at the same time, by the peculiar juxtaposition of colours, to give a distinctive charm as of an object illuminated by coloured lights from opposite sides, and sometimes giving the effect of iridescence.

Fig. 3.



The diagram, Fig. 3, will show at once how the operation is performed and serve for an analysis of the effect.

For the sake of an illustration, we have assumed that the colours red and green are being used, and a single elevation of the surface is indicated for the purpose of more easily illustrating the process.

If a green colour is distributed from the position of the arrow marked "Green" (approximately an angle of 45 degrees), the embossed or raised portion between the indicated lines A and B will receive the fullest amount of colouring; the portion indicated by B, C, will receive little or no colour; while the flat surfaces outside of A and C on either side of the embossing will receive a diminishing quantity of colour. When the red is distributed from the opposite angle, the green on the portion marked A, B, will be left a pure tint, the portion B, C, will be coloured red, and

the surfaces outside of A, C, will be a neutral tint, composed of the blending of red and green. The effect is twofold, as before hinted.

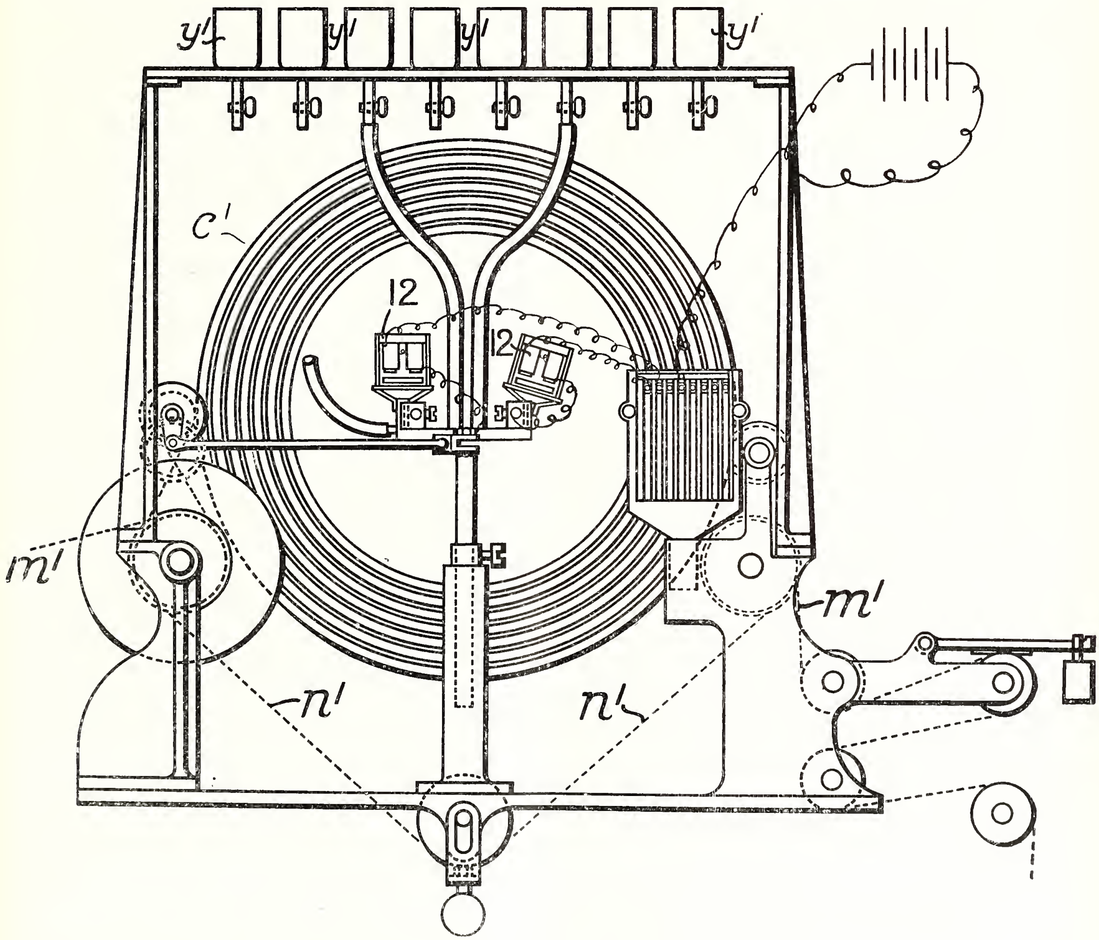
1. The very delicate blending of two colours in juxtaposition give a charming colour effect. The colours as they fall over the receding portions of the relief produce most delicate gradations, and when certain tints are employed an effect of iridescence is produced.

Artists frequently employ the effect of illumination by a coloured light, as lamp light or sunset light, to add a charm to their pictures, and the result of this method of colouring with the aerograph is somewhat analogous in its effect.

2. By the heightening of the effect of relief. This is obtained by a single colour, but when two colours are employed one may be darker than the other, and so this effect may be retained. An ordinary white embossed surface does not yield to the eye the more delicate modelling unless it is placed with a direct light falling across the surface, so that the relief casts a shadow, but if colour is blown on to one side of the embossing, the effect of relief is made permanently visible in an ordinary light, and all of the detail and delicate gradation of relief become perceptible to the eye.

These effects can be produced with this machine in two colours at one operation and at the speed of litho printing.

FIG. 4.



As to the colour used I would say that any liquid colour may be used in this machine. All of the more permanent pigments are available, in practically any medium, oil, water, or spirit. Pure varnishes may be used to give transparency to colour and finish to surfaces.

And now I come to the description of another machine which is the outgrowth of the aerograph method of distributing colours. I refer to a continuous stencil machine for printing or colouring fabrics in continuous lengths. As

this machine is too large and too elaborate to set up here for a practical demonstration, I have had some diagrams made, and beg your indulgence for a brief technical description.

There have been many attempts by inventors to make a continuous stencil machine in which the colours were distributed by compressed air, but with only poor success. One reason for this has been the crude and imperfect type of spray which has been employed; and another cause of failure has been the inadequate means of keeping the stencil clean.

Fig. 4 shows an end view of my machine looking into the end of the continuous stencil drum. 12-12 are sprays mounted in two series (see Fig. 2) within the stencil in position to distribute colour on to the bottom of the stencil as it revolves. The material to be operated upon, *m'*, guided by tension rollers, passes under the stencil drum, and is kept in contact thereto by means of the continuous belt, *n' n'*. Colour is supplied to the sprays from cups, *y' y'*. The air and the colour are both under perfect control, so that it is possible, while the machine is running, to increase or decrease the amount of colour delivered from each spray individually, or they can be controlled all at one time.

I have used two systems of control, one is by means of levers; but the more efficient method is by means of electricity; this enables the sprays to be placed in any position and controlled by an electric circuit breaker.

The sprays may be used inside of or outside of the stencil, or both at one operation by having two sets of sprays. Blended shadings of colour for rainbow tints are obtained; the soft patches of various colours may be made in alignment, or the sprays may be automatically moved about and will produce all kinds of irregular shapes; the different colours being blended more or less into each other according to the distance from the surface.

The electric control is made by placing small magnets above each spray and attaching the air and colour valves to the armatures.

A disc of perforated metal is carried in the frame which holds the stencil, and the electric terminals are allowed to make contact opposite the perforations, and while the contact is maintained, the particular spray with which it is connected will be in operation. In this way it is possible to shade the petals of a particular flower in the pattern and repeat the operation indefinitely.

As with the flat stencil so with this: a serious obstacle to success was keeping the stencil clean; this has been accomplished by means of suction. Air is exhausted from a tube having an opening between two blades mounted so that the opening comes near to, or in contact with, the inside of the stencil; when the air is exhausted from this tube the loose colour on the stencil is taken up and carried to a chamber.

The length of my paper does not permit of a more detailed description. I trust you have obtained a general idea of the construction of this machine, which has cost me several years of hard labour.

The speed at which the colouring or printing is done is about 10 métres per minute, but there is no reason, except the drying of the material, to prevent it from running two or three times as fast.

The number of colours or tints which may be employed at a single operation is only limited by the number of sprays. As constructed at present, we employ 24 sprays for 75 centimétres width.

The peculiar merit which will recommend the machine, is the perfect shading and blending of various colours which are possible in a single operation, a single stencil taking the place of several expensive engraved rollers.

Attempts have been made to print several colours from a single engraved roller by graduating different coloured inks, but with very indifferent success, and I believe it has never been attempted to make one colour follow another, and blend with it in the same alignment.

This is an effect easily possible with my machine. We shall be able to show those interested a few samples of the work, but we have not yet found time to make more than a few designs, which will only give an imperfect representation of its possibilities.

Speaking broadly, both of these machines which I have described possess the limitations which are imposed by a stencil.

On the other hand, we escape from the limitations of an inking roller, which admits of but one colour at a time, while the spray method admits of many tints either superimposed, blended, or delivered in different parts simultaneously.

But perhaps it is the quality of sprayed work which will recommend it most, the irregular and exceedingly fine grain and the beautiful gradations of colour which are possible.

DISCUSSION.

Mr. HERBERT S. STARNES thought he ought to give a word of warning to anyone using the air brushes described by the author because he had found there was a danger in their use, which in 99 cases out of 100 would be unsuspected. If the colour contained anything of a poisonous nature it was drawn with the spray into the lungs, and might be the cause of serious injury. He found that out in the following manner:—In experimenting with one of the larger air brushes, which held about two ounces, he believed, to coat paper for a new photographic process, he thought he would try coating the paper in the ordinary way, and then spreading the pigment on with the sensitiser, *i.e.*, a diluted solution of bichromate of ammonia. In a few minutes he was suffering from every symptom of a very bad influenza cold. There was no doubt whatever that it was a case of bichromate poisoning. Fortunately the action of the bichromate was so rapid that he was able to stop it at once; but in many cases where pigments of a less poisonous or less irritant nature, such as lead and other chromate compounds were used, serious injury to the lungs might be caused without any possibility of the root of the mischief being suspected. He, therefore, strongly suggested that when anyone used colours of the nature he had described, they should use a respirator or muffler over the nose and mouth to keep the minute particles in suspension in the room out of the lungs when using air-brushes. He hoped what he had said would not in any way detract from the use of the machine, but be thought the word of warning he had given would prevent the recurrence of the serious difficulty he had met with.

Mr. J. S. SUNDERLAND said there was no doubt that the aerograph was an exceedingly useful instrument. It would be a great advantage if the artist, in working up a picture which was to be used for the three colour process, only used red, yellow, and blue pigments, which were harmonious with the colour filters used. If that was carried out, it would considerably help the production of many illustrations by the three-colour process. If artists who were working up such things as bromide prints for three-colour work would adopt that plan, he thought it would be exceedingly advantageous.

Lieut.-Colonel ALLAN CUNNINGHAM inquired whether the instrument the author had used in making his drawings was the same, or an improved, form of instrument shown by himself several years ago at the Society of Arts, under the name of the air-brush?

Mr. BURDICK replied in the affirmative.

Lieut.-Colonel ALLAN CUNNINGHAM desired to point out that the instrument so used was by no means a mere machine, because in the hands of an artist like the author of the paper it had produced two exceedingly beautiful head studies in a few minutes, and was capable of rapidly producing whatever the artist desired. As the air-brush was applied many years ago, it apparently had a very limited application, and he, therefore, thought the inventor was to be congratulated on the very great advance and improvement he had made in the form of the machine, by converting it into an instrument which, in a short space of time, enabled an artist to turn out very beautiful results in many colours and in great quantities. He had no doubt that the difficulty connected with the poisonous nature of the materials used could be remedied by means of suitable appliances.

Mr. WALTER F. REID enquired whether the aerograph could be used for a solution of a thick consistency. The colours which had been used by the author in the drawings he had made, were apparently rather thin, but there were many very important uses to which the instrument could be put with thicker paints, such as oil paints. A somewhat similar machine was used at the St. Louis Exhibition for painting the structures. In the manufacture of linoleum a machine was badly needed which could paint with thick paint, a certain thickness of pigment being necessary on the wearing surface of the linoleum; and he had recently seen an apparatus that was developed, he believed, in Sweden, which actually painted the linoleum by means of compressed air which was now coming largely into use. The author's form of spray seemed to be a very effectual one. There were several valuable machines in existence for spraying vegetables and fruit trees, but Mr. Burdick's machine seemed to him to be extremely efficient. The testimony of a previous speaker as to the machine impregnating the air of a room with the material used pointed to a new application of the machine. For instance, it might be used very well indeed for distributing disinfectants in a sick room. Of course anyone using poisonous substances would be compelled by the Factory Acts to provide efficient ventilation, so that no trouble would arise on that score, but it was very useful for the experimenter to know that a danger existed so that he might avoid it. He would be glad if the author in his reply would state whether any special pigment was required, because he presumed that the ink would not dry quickly enough if too much was put on.

Sir HENRY TRUEMAN WOOD (Secretary) said that the process of painting by spray had, he believed for the first time, been employed on the Chicago Exhibition Buildings. The original form of aerograph or air-brush, as all photographers knew, had been of extreme value for commercial purposes in working upon photographs and also in preparation for process work, because the grain which it gave was easily reproduced in the process block and served for printing. In looking at the machine previous to the meeting, he had been struck with its extreme ingenuity,

and he recommended all those who were interested in mechanics or in printing processes to investigate it for themselves. The device used for cleaning the stencil was very ingenious. It was easily understandable that a stencil naturally got clogged and blocked up—the colour ran over the edge and blurred. The reader of the paper had succeeded in making his stencil clean after every use of it by sucking off the surplus colour by means of an air blast, which was not only a very ingenious but an extremely novel device. There were many other nice points in the machine, such as the automatic cut-off by which, as soon as the pressure of the air in the cylinder reached a certain point, the lever was shifted and the belt was thrown off on to the idle pulley. He thought Mr. Burdick was to be congratulated on bringing to the notice of the Society such a greatly improved and ingenious apparatus after eleven years work, but he suggested that the paper would be more valuable if a little further information was given. It was a commercial question, more than anything else, as to the comparative cost of the production of work by the aerograph and by the ordinary litho process. For small quantities he thought the aerograph would have it all its own way; but for large quantities, in which the question of the cost of producing rollers was not so important, he thought the ordinary printing machine would have it, more or less, its own way. He felt a little sorry that so purely mechanical an apparatus had been introduced into Japan, and he was afraid it was only one of the instances in which the charm of Japanese art would, to a certain extent, be lost and destroyed by the introduction of Western methods, to the regret of the lovers of such original art in this and other countries.

Mr. Reid asked the author to be kind enough to explain the origin of the word aerograph, because in the United States an aerograph was invariably presumed to mean something connected with wireless telegraphy.

Mr. Burdick, in reply to Mr. Starnes, said the question of the spray being taken into the lungs was a very old one. Ordinary colours which were not poisonous did not seem to have any deleterious effect unless they were used in a very close room. Sometimes workers operated against a wall, and the colours therefore came back to them again; but the natural tendency of the instrument was to blow the colour away from the operator. Perhaps Mr. Starnes, who had such an unfortunate experience, was working in a close room, with a wall in front of him which sent the colour back. In the Potteries, where lead glaze colours were used almost exclusively, draught boxes with fans were put into the workshops, and they were very favourably mentioned by the Health Inspector in Staffordshire, who, in one of his reports, said he was glad the aerograph was being used, as it superseded the old dusting process, which was more dangerous. He did not quite understand Mr. Sunderland's point with regard to the three-colour process. The aerograph was being used for preparing pictures for the three-colour process, and he believed it was found very useful. A question had been asked as to what colours could be used. Water colours had been on the machine in operation, and a spirit colour for the stencil work, because it dried quickly. He could put one stencil on over another without spoiling the work, or having to wait for it to dry. The other colour he had used was an ordinary water sepia, and a very permanent pigment. All the water colours, oil colours, and spirit colours were used in the aerograph; in fact he had been able to use any liquid colour that he had come across. Enamel paint of its consistency when purchased in tins was sprayed direct on to the woodwork; and a number of aerographs was being used in the dockyards at the present moment for painting battleships both inside and out. He supposed he (Mr. Burdick) would have to be held responsible for a good deal of the bad work done with the aerograph, because he knew that bad work had been done, but good work had also been done. An instrument could hardly be judged by the bad things it did; because, after all, there were a lot of such things done with an ordinary brush and crayon. The word aerograph was his own invention. He adopted it because there seemed to be a confusion between the machine and a previous crude spraying-machine which was adopted in England about twenty years ago, and used to a great extent; but when he came to England about twelve years ago it was practically abandoned. That instrument was called the air-brush, so he called his instrument the aerograph. With regard to Sir Henry Wood's remarks on Japanese art, there was no doubt that the Japanese used sprays a good many hundred years ago. Some of the very old Japanese ware showed distinct evidence of spray, some of it quite a coarse spray, and it accounted, he thought, to some extent, for the charm of the work.

The Chairman thought the members were greatly indebted to the author for a most interesting paper, while the practical demonstrations had added a good deal of interest to the evening. Mr. Burdick had said that the use of the aerograph had developed rapidly in commerce, but had made less progress in those arts where precedent and prejudice were strong. That, he thought, must naturally be the case. Drawings and pictures of any description bore the touch of the artist, and that was the great charm of them. He should be very sorry indeed to see freehand drawing ousted in any School of Art and a mechanical invention of any description taking its place. He trembled to think what might happen in the future if the author's clever little instrument was used too extensively outside its own particular province. He pictured an artist sitting, perhaps, in the Weald of Kent, endeavonring to portray the landscape in front of him

on his canvas or sketch-book, working away with an electric portable machine under his camp-stool, while the glories of the setting sun were rapidly pumped through a tube on to the drawing by means of an aerograph! He did not wish for one moment to minimise the importance of the invention, but simply desired to point out that its future use would, in his opinion, be far more successful if Mr Burdick's ambitions were not aimed too high. He had always been very much interested in the good old art of wood engraving, which had gradually almost disappeared off the face of the earth, with the exception that in the last few years mechanical drawings, such as engines, had been produced by engraving, and remarkably well produced too. But he had seen such wonderful specimens of engine work reproduced by means of the aerograph that he was afraid the last days of the wood engraver had come, and that he would have to disappear altogether. One speaker had referred to the danger of the aerograph; but that he thought must be more in the pigments used than in the machine itself. He went round to inspect an aerograph at work in one of the process engravers, and there saw two very charming young ladies, in apparently excellent health, hard at work, and there did not seem to be any signs of poisoning about them. The uses to which the aerograph could be put could be magnified, he fully appreciated, to an enormous extent, not only in the production of fabrics, pottery and wall decorations, but for process engraving. A large number of photographs were continually being received by the illustrated press, in which very often the details of the backgrounds were too obtrusive or not sufficiently prominent, and it was better to illuminate them. He had seen some specimens of work of that description done with the aerograph in which he was greatly surprised at the character of the work. It was his pleasant duty to propose a hearty vote of thanks to Mr. Burdick for his most interesting paper.

The resolution of thanks having been carried unanimously, the meeting terminated.

COTTON CULTIVATION IN CYPRUS.

The decay of an industry in any centre in which it at one time flourished, is a subject which no administrator can lightly disregard. In the case of a deposit of mineral ores becoming exhausted, nothing can be done. Very often, however, if the industry be of an agricultural nature a revival can be secured. In the case of the cotton growing industry of Cyprus, a report by Professor Wyndham Dunstan,* both discusses the reasons for the decay, and shows how, by improved methods, a once important industry may be resuscitated.

* Report on the Agricultural Resources of Cyprus, with special reference to Cotton Cultivation, No. Cd. 2,717. Wyman and Son, Ltd. Fetter Lane, E.C. Price 5d.

Cyprus was, at one time, famous for its cotton, the fibre being then regarded as among the finest produced in the Levant. During the Venetian occupation, Cyprus annually exported from 7,000,000 to 15,000,000 lbs., producing a grade then specially esteemed in England. Passing into Turkish hands, the cultivation declined, save for a rally during the American Civil War, when the scarcity in Lancashire led to a considerable, but temporary, increase in cotton-growing throughout the island. Since the British occupation in 1878, no considerable or permanent increase in cotton cultivation has occurred, although since 1890 the practice of taxing the crop in the field has been abandoned for a tax on exported cotton. In recent years, the average production has not exceeded one million pounds, of which about one-half is exported, mainly to Marseilles and Trieste. The acreage now under cultivation is, at most, about four thousand acres, while in Venetian times about 60,000 acres of land must have been under cultivation of cotton for export alone.

The cultivation of cotton is now chiefly conducted by small proprietors or leaseholders, the amount of cotton grown being subject to considerable fluctuation depending mainly upon the suitability of the season, as regards rain, for cotton growing, as well as on the probable value of the cotton crop as compared with cereals and linseed. During the American Civil War some "Orleans" seed was introduced, and did well on irrigated land. Hybridization with the native plant resulted, and a very extensive degeneration of the cultivated cotton has occurred. Cultivation is carried on in an exceedingly primitive fashion, the native wooden plough is generally used, the seed is collected without special selection, and water is pumped by water wheels. Although the quality is poor the yield is high, a low estimate being 250 to 300 pounds of ginned cotton per acre, as against 180 lbs. in America. Egypt, under careful cultivation, produces on an average 450 pounds per acre, a figure often reached in Cyprus. Professor Dunstan estimates the profit to the cultivator, exclusive of land, manure and water charges from £3 15s. to £4 per acre.

After leaving Cyprus Professor Dunstan visited some of the cotton fields in Lower Egypt, and there found plants already six inches in height before the seed had been sown in Cyprus. With regard to the reestablishment of the industry in Cyprus the climate and soil are both favourable. There is no frost at the time of planting and no rain is likely to spoil the ripened crop. Day and night temperatures are equable, and the one deficiency is rain during the early stages of growth, to remedy which recourse must be made to artificial systems of irrigation. Analyses of the soil shew that it contains the ingredients necessary to the nutrition of cotton; lime and potash are abundant, and phosphate, is present in sufficient quantity. In one district the soil is a rich, sandy loam, many feet in depth, which, with the addition of suitable manure, would yield

heavy crops. Agricultural labour is readily obtainable; a labourer usually receives £12 per annum and finds his own board and lodging.

The three principal obstacles which interfere with the extended cultivation of a good quality of cotton, and its export to the United Kingdom are:—

1. The absence of an effective system of irrigation.

2. The absence of an agricultural department qualified and equipped to conduct systematic experiments, with a view to the improvement of cotton culture, and to supply information and advice to the native cultivator.

3. The absence of shipping facilities, and especially of a direct service to England with low freight rates.

These three essential features are discussed at length, and the report proper concludes with some "general considerations," in which it is stated that if the industry were developed, there would within a few years be an area of 10,000 or 20,000 acres, producing $2\frac{1}{2}$ to 5 million pounds of fibre, and eventually several hunded square miles might be brought under cultivation.

An appendix to the report contains proposals for the organisation of an agricultural department in the island. The correspondence relating to the report, which is printed with it, in addition to its technical value, is of interest as instancing the difficulties confronting the British Cotton Growing Association in the furtherance of its work.

ALUMINIUM PAPER.

Aluminium paper is now manufactured in Germany and recommended as a substitute for tin foil. It is not the so-called leaf aluminium, but real paper coated with powdered aluminium, and is said to possess very excellent qualities for preserving articles of food, for which it is used as a covering. Chemical analysis, according to the American Consular representative at Frankfort, has proved that aluminium paper contains but few foreign substances; occasionally it may contain up to 2 per cent. of iron, but never any arsenic or other poisonous metals. Hence it appears that the powdered aluminium used for the manufacture of aluminium paper is relatively pure. The paper used is a sort of artificial parchment obtained through the action of sulphuric acid upon ordinary paper. The sheets are spread out and covered upon one side with a thin coating of a solution of rosin in alcohol or ether. Evaporation is precipitated through a current of air and the paper is then warmed until the rosin has again become soft. Then powdered aluminium is sprinkled upon it, and the paper subjected to strong pressure to fasten the powder thereon. The metallic covering so obtained is neither affected by the air nor by fatty substances. Aluminium paper is much cheaper than tin foil and will, so it is thought, in Germany, become a strong competitor of the latter.

HOME INDUSTRIES.

Gambling in Cotton.—In his interesting and suggestive speech at Manchester last week, upon cotton cultivation, Mr. Balfour said nothing is more certain to check gambling in cotton than what may be called the diffusion of the cotton area. Just as when the United Kingdom depended upon its own corn fields for its wheat supplies there was alarming oscillation in prices, so now, whilst we remain so largely dependent upon the Southern States of America for our supplies of cotton, we must always be more or less at the mercy of the gamblers in cotton. Given large supplies of cotton from other countries than the United States, and the effect of a short crop in that country will be neutralised by good crops elsewhere, just as now wheat remains cheap even when, as last year, wheat imports from the United States are less by millions of quarters, because ample supplies can be drawn from other countries. But it has to be remembered that it is much easier to plant large areas with wheat than with cotton. It may be that other countries have a soil and climate as suitable for the growth of cotton as the United States, but they have not the labour. The "huge tropical areas" of which Mr. Balfour speaks are either sparsely populated, or populated by those to whom continuous labour is repugnant. The emancipated slaves, or rather their descendants, in the Southern States of America, are ideal labourers, steady workers at a modest wage, and it is this, coupled with efficient machinery, which enables the cotton planter in those States to make a good living out of cotton growing at prices that leave no margin of profit elsewhere. It is not likely that the extension of cotton cultivation will materially lower present average prices; what it may do is to prevent any serious rise in price, a rise that is inevitable, and must be disastrous to British interests, if the world, with its rapidly growing demands, remains dependent, to anything like its present extent, upon the cotton fields of the Southern States of America for its supply of cotton. It would be difficult to exaggerate the national importance of this extension of cotton area, and it is encouraging to be told by the Chairman of the British Cotton Growing Association that its work is likely to be less hampered by want of adequate capital than was feared, and that there is reasonable anticipation that the cotton supplies from within the British Empire, more especially from West Africa, will be largely increased in the near future.

Swiss Trade and British Goods.—In his report on the trade of Switzerland, just issued (Cd. 2682), the British Commercial Agent in that country gives some suggestive figures as to the number of commercial travellers visiting Switzerland in 1904, and the trade done with their respective countries. The total imports in 1904 were of the value of £49,603,000, the imports of manufactures being valued at £15,558,000. The number of commercial travellers who visited the country was 6,917:—

Country.	Total Imports.	Manufactures.	Percentage of Manufactures.	Number of Travellers.
	£	£		
Germany	15,058,000	8,108,000	52·7	4,785
France	9,957,000	2,717,000	17·4	1,319
Italy	6,775,000	529,000	3·4	415
Austria-Hungary	3,285,000	1,040,000	6·6	249
United Kingdom	2,301,000	1,717,000	11·0	41
United States	2,153,000	463,000	2·9	2
Belgium	1,046,000	556,000	3·5	65

While Switzerland exported to the United Kingdom finished goods to the value of £6,800,000, her purchases of British manufactures only amounted to £1,717,000. In Mr. Milligan's opinion, more business might be done with Switzerland by British firms if the travellers representing them were better equipped for their work.

Pirating British Designs.—Reference was made in the *Journal* some little time ago to the pirating of British designs by foreign manufacturers, more especially Germans and Americans. Many of the witnesses examined by the Tariff Commission now sitting, and which is, it will be remembered, unofficial, make complaint under this head. For example, Mr. Kaye, of Kaye and Stewart, worsted manufacturers, of Huddersfield, told the Commission that America, France, Germany, and Austria pirate British specialties and designs, and copy them in their own factories. British manufacturers seem unable to protect themselves. They are obliged to expose their designs nearly twelve months before the goods are actually worn, and immediately the designs are exposed the foreign manufacturers obtain them (produced at great cost), and forthwith reproduce them without let or hindrance. This appears to be a deliberate policy, practised year after year, and could not be met by registration abroad, since that would necessitate stating exactly how the cloth is made. Mr. Kaye says that his own firm spends from £8,000 to £12,000 every year in designers' wages, the materials they use, and the wages paid to weavers to weave patterns. This expenditure is almost entirely saved by the foreign pirates. Mr. Kaye told the Commission that he had seen his own design pirated by a Spanish firm, and woven in a mill near Barcelona. He has also seen his own patterns carried round to American merchants by American manufacturers, and orders taken for them. Apparently the British manufacturers cannot retaliate. British designs seem to meet the foreign taste, whereas the foreign designers—and there must be a good many of them—are not equally appreciated in the United Kingdom.

The Woollen Industry.—A noticeable feature of the evidence taken by this unofficial Tariff Commission on the woollen industry is the concurrence of opinion as to the comparative uselessness of technical education as taught in England. Thus Mr. J. Bence, manufacturer of mohairs at Bradford, tells the Commission that he has had the advantage of a foreign, commercial, and technical training, both in France and Germany, but he would "turn all the technical schools to something else, rather than let them spend money as they are doing." Students, says Mr. Bence, "may understand theoretically how to make a cloth, but they do not, from what I have seen, know how to produce that cloth to sell, which is the main thing. I have had a case of a man, a typical example of the result of English technical training, who was no doubt very clever from the examiner's point of view, but he was not worth twopence as a man of business. All applications from young men who apply to me with their gold medals and certificates, and so on, I put into the waste-paper basket." This might be taken to be no more than the prejudiced opinion of one of the old school, but it is by no means an isolated expression of opinion. It is found again and again in the evidence of witnesses. The idea seems to be that the commercial side of education is too much neglected, and that it would be better if students were induced to think more commercially, and less about the intricacies of a fancy weave.

India-rubber.—There has been some discussion during the week as to the number of India-rubber trees that can properly be planted upon an acre, the figures ranging from 200 to 1,000. It may be interesting to note what Mr. W. H. Johnson, who is Director of Agriculture in the Gold Coast Colony, and was commissioned by Government in 1902 to visit Ceylon to study the methods employed there in the cultivation and preparation of Para rubber, says on the subject in his report published last year. In Ceylon, he says, he found the commonest distance at which these trees were planted, or land cultivated with nothing but Para rubber trees, to be 12 feet by 12 feet (290 to the acre), but 40 feet by 40 feet (25 to the acre) when planted amongst tea. It will, however, generally be found necessary to thin out some of the former as the trees increase in size. In the Straits Settlements the distance varies between 10 feet by 10 feet (435 to the acre), and 36 feet by 36 feet (33 to the acre). Mr. Johnson saw trees in Ceylon aged about ten years, planted 40 feet apart, with their branches touching. It must, however, be borne in mind that Para rubber tree cultivation is in its infancy, and the proper distance to plant the trees apart is a matter which will require experience extending over a long period to settle satisfactorily. Mr. Johnson thinks it probable that the best results will be obtained by planting fairly closely, say from 15 feet by 15 feet to 20 feet by 20 feet apart—*i.e.*, 182 and 108 trees per acre respectively—and afterwards thinning out weakly trees as they become crowded. As to yield, about which there has also been some discussion, it varies greatly. So far as plantations are concerned, and assuming careful selection of site and attention to cultural details, about half the trees should be ready for tapping in the sixth year, and the following year the average

yield would be about ¾ lb., with 1 lb. in the eighth year.

Railway Electrification and German Contractors.—It is not to be wondered at that surprise and soreness have been expressed and felt at the fact that the London Brighton and South Coast Railway Company have given the contract for the electrification of a portion of their line to a German firm. As was to be expected the Chairman of the Company has met criticism by pleading that the Directors have to think of the interests of their shareholders, and if a German firm of adequate standing is ready to do the work cheaper than any British competitor it cannot be refused it simply because of nationality. A correspondent of *The Times* argues that "the capture of this contract was simply a matter of tactics in which the English firms tendering were got the better of by superior talking abilites." Without information that has not been made public this explanation is not convincing, and it must be assumed that the consulting engineers of the Company gave the work to the German firm because the German tender was substantially lower, and more advantageous to the Company in other ways, than that of any one of the tenders of British firms. It is so far satisfactory to know that under the contract much of the work will be done by English hands, but it is surprising, and even disquieting, that home firms have to take second place in such a matter.

Turbines v. *Quadruple Expansion Engines.*—The result of the *Carmania* trials would seem to put beyond doubt the superiority of the turbine for Atlantic quick service. The two Cunard liners, *Carmania* and *Caronia*, were built in the same yard, and are identical in all respects save that the *Caronia* is fitted with twin screws driven by quadruple expansion engines whilst the *Carmania* is fitted with turbines. The trials of these two vessels were looked forward to with great interest as a crucial test of the turbine system of propulsion for vessels of the largest size—both the *Caronia* and *Carmania* are of 30,000 tons displacement—and the turbine, as used by the *Carmania*, has fully justified the expectations of her friends. The *Carmania* beat the *Caronia* by about a knot in speed, which means 16 per cent. more horse-power, with corresponding economy in working. The Allan Company have two liners running with turbine engines, and excellent results are reported. Here, at any rate, Germany is a step in arrear.

OBITUARY.

EDGAR HORNE.—Mr. Horne, chairman of the Prudential Assurance Company, died on Monday, 18th inst., at his house at Eastbourne. He was the son of Mr. William Horne, wharfinger at Falcon Wharf, Bankside, and was borne on April 17th, 1820, at Clapham. He attended Dr. May's school at Enfield, and in *The Times* obituary it is stated that the late Sir Frederick Bramwell was one of his schoolfellows; and further, that Charles Lamb, who was a friend of Dr. May, on one occasion delivered an address to the pupils. On leaving school, Horne entered the office of Mr. John Eversfield, auctioneer and surveyor, and from that time until his death he was continuously connected with the firm, although for some years he had not been engaged actively in the business. In 1848 he founded, in eonjunction with Mr. (now Sir Henry) Harben, the Prudential Assurance Company, and became chairman in 1877. Mr. Horne was a past master of the Clothworkers' Company, and chairman for many years of its Estates Committee. He was a burgess of the City of Westminster, and churchwarden of St. Margaret's. He was elected a member of the Society of Arts in 1878.

GENERAL NOTES.

MEMORIAL TABLETS. — The memorial tablet placed by the Society of Arts in 1876 on the house No. 27, Baker-street, to record the fact that Mrs. Siddons lived there, was removed when the building was taken down to make way for the extension of the Baker-street Station. The tablet has now been affixed by the London County Council on the new building, with a record of the fact that the premises were rebuilt in 1905.

THE IVORY COAST.—Mr. Vice-Consul Armstrong's report on the trade of the ivory coast for 1904 is noteworthy in more than one way. Here we have a French colony which does a larger trade with the United Kingdom than with France. The figures are as below:—

Country.	Value. Imports.		Value. Exports.
	£		£
United Kingdom	279,952	..	246,922
France	344,675	..	145,206

A difference of £36,993 in favour of the United Kingdom. The balance in its favour would have been much larger but for the importation of specie and materials from France for the railway and harbour works. As it is the exports to the United Kingdom amount to more than the total amount done with all other countries combined. It would be difficult to find another instance of the balance of trade being so much in favour of a foreign Power. It is largely due to the fact that rubber is by far the most important of the exports of the ivory coast, and that nearly the whole of it goes to Liverpool.

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FRIDAY, DECEMBER 29, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 3, 7 p.m. (Juvenile Lectures.) PROFESSOR HERBERT JACKSON, F.I.C., "Combustion and Flame." (Lecture I.)

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, at 7 o'clock, by PROFESSOR HERBERT JACKSON, F.I.C., on "Combustion and Flame."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

REPORT ON LEATHER FOR BOOK-BINDING.

The enlarged and illustrated edition of the Report of the Committee on Leather for Bookbinding is now ready. It is published by Messrs. George Bell and Sons, of York-house, Portugal-street, W.C., at the net price of 10s. 6d. Members of the Society requiring a copy can obtain one, at a discount of 25 per cent., by applying direct to the Secretary of the Society.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE MEASUREMENT OF HIGH FREQUENCY CURRENTS AND ELECTRIC WAVES.

BY PROFESSOR J. A. FLEMING, M.A., D.SC., F.R.S.

Lecture I.—Delivered November 27th, 1905.

MEASUREMENT OF HIGH FREQUENCY, CAPACITY, INDUCTANCE, AND RESISTANCE.

On two previous occasions, I have had the honour of giving lectures in this room "On Electric Oscillations" and "On Hertzian Wave Telegraphy." Since that time, our knowledge of the subject has made great progress, especially with regard to quantitative measurements. When any branch of scientific research begins to receive technical application, we always find that it calls for processes of exact measurement, and, in truth, we may say that any collection of facts only becomes scientific knowledge, just in proportion as it is capable of being made the subject of precise measurement.

In these lectures, I propose then to direct your attention to the "Measurement of High Frequency Electric Currents and Electric Waves," and the course may be in one sense considered as supplementary to, or a contination of the two previous ones. Limitations of time will render it necessary for me to assume that you are familiar to a certain extent with the general phenomena.*

The first matter which must engage our attention is the measurement of electric capacity. When a charge of electricity is given to

* For further information, the reader is referred to the previous Courses of Cantor Lectures on "Electrical Oscillations and Electric Waves" (1900) and "Hertzian Wave Telegraphy" (1903).

The blocks illustrating these lectures have been kindly lent by the proprietors of *Engineering*.

a conductor, the result is to raise what is called its potential, just as when a quantity of heat is imparted to a body, the result is to raise its temperature, or when a quantity of water is put into a vessel the result is to raise the level of the water. Potential is therefore to electricity what temperature is to heat and level to liquids. Heat tends to flow from places of high temperature to places of low. Water tends to flow down hill, and electricity to move in the direction in which potential diminishes most quickly.

The ratio of charge to potential is called the capacity of the body, and capacity may be defined as the electric charge required to raise a conductor to unit potential. The potential of the earth is taken as the zero. Accordingly we have the following definition :—

Definition.—The electrical capacity of a conductor is measured by the quantity of electricity which must be put into it to raise its potential one unit above that of the earth, all other conductors being at a great distance.

Since there is no absolute potential any more than absolute level, we take the earth's potential as zero. We have next to settle the units. We have first a definition of the unit of electric quantity.

Definition.—The electrostatic unit of electricity is the quantity which repels another equal quantity at a distance of one centimetre with a unit of force. The unit of force is called one *dyne* and is $\frac{1}{981}$ part of the weight of one gramme.

A conductor charged with electricity possesses a store of energy, and requires expenditure of work to charge it. It gives up this energy on discharge. Hence we have a further definition.

Definition.—A body is charged to unit potential when a unit of electric quantity on it represents a store of one unit of energy.

We may, therefore, employ a small conductor charged with one electrostatic unit of quantity to measure the potential of any other charge by ascertaining how much work is required to move the unit charge against the electric attraction or repulsion of the other charge to or from an infinite distance, or which comes to the same thing, to or from the earth. The law governing the electric attraction or repulsion between particles of electricity is the same as that of gravitation between particles of matter, viz., the law of the inverse square.

Imagine then a sphere of radius R, charged with Q units of electricity. It exercises an attraction of Q/d^2 units of force on a unit of charge of opposite sign placed at distance of d centimetres from its centre, and it can be shown by a simple calculation that the work done in moving a charge to an infinite distance is Q/d units of energy, or ergs. Hence we have $V = Q/R$ or $C = Q/V = R$, and, therefore, that the capacity of a sphere of radius R centimetres is R electrostatic units.

The practical unit of capacity is called 1 microfarad, and is equal to 900,000 electrostatic units. The capacity of the whole earth is about 800 microfarads, or nearly the same as that of an Atlantic cable. The microfarad is, however, too large a unit for the measurements we have in view, and hence I employ the one-millionth part of it, or the micro-microfarad (m.mfd.), as a convenient unit. This is equal to that of a sphere 9 millimetres in radius, about the size of a large cherry, whereas the microfarad is the capacity of a sphere 9,000 metres, or about $5\frac{1}{2}$ miles in radius. It is important to bear in mind the rule that to convert capacity measured in electrostatic units into capacity measuring microfarads we must divide by 900,000.

There are certain regular forms of conductors for which the electrostatic capacity can be mathematically calculated. These are the sphere, a circular disc, an ellipsoid, a long straight wire, and the following Table I. shows the mathematical expressions for these capacities in electrostatic units (E.S.) and in micro-microfarads (m.mfds.).

TABLE I.

Capacity of	In E.S. Units.	In m.mfds.
Sphere	R	$10\, R/9$
Disc	$2R/\pi$	$20\, R/9\pi$
Vertical Wire	$l/2 \log_{\epsilon} 2h/d$	$l/4 \log_{10} 2\, h/d$
Horizontal Wire	$l/2 \log_{\epsilon} 4h/d$	$l/4 \log_{10} 4\, h/d$
Parallel Plates	$A/4\pi t$	$10\, A/36\pi t$
Concentric Cylinders..	$l/2 \log_{\epsilon} \frac{D}{D'}$	$l/4{\cdot}15 \log_{10} \frac{D}{D'}$

The letters in the above formulæ signify as follows :—

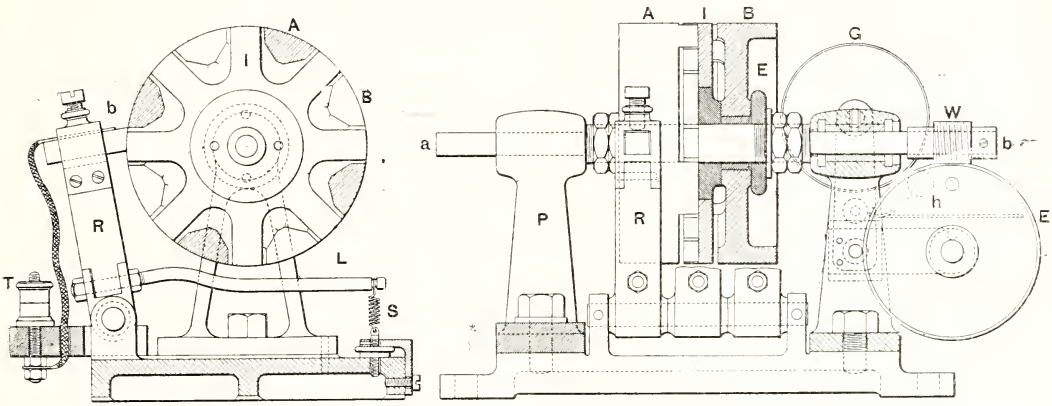
l = length of conductor.
R = radius of sphere or disc.
d = diameter of wire.
h = height above the earth.
D = diameter of the sphere, disc, or cylinder.

The proximity of any other conductor, even the earth, raises the capacity of the conductor. A large sphere hung up in this room would have a capacity numerically greater than its radius when reckoned in

electrostatic units by reason of the proximity of the walls of the room.

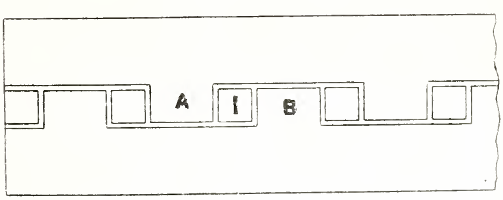
The only method of finding the capacity of most insulated conductors is to do it experimentally. This is best achieved in the following manner:—If we charge the conductor and discharge it through a galvanometer, say, 100 times per second, these numerous discharges are equivalent in effect to a continuous electric current. Suppose that the galvanometer has been calibrated so that we can interpret its deflections and ascertain the value of the current in microamperes, which produces any given deflection. Let V be the potential to which the conductor is charged, C, its capacity in microfarads, and V, the number of discharges per second, we have then the relation, A = C N V. Hence the capacity can be determined when the numerical values of A, N, and V are known. This process is best conducted by means of a rotating commutator. The particular form of commutator here exhibited was designed by the author in conjunction with Mr. Clinton. (See Fig. 1.) It consists of a barrel or drum driven by an electric motor. This drum consists of three parts, the two outside portions have projecting teeth like those of a wheel, and there is an intermediate wheel which is insulated from and fixed between the other two. The diagram in Fig. 2 shows the development of the surface of this drum. Against the drum, three brass brushes press, two against the outer portions and one against the middle, and it will easily be seen that when the drum rotates the effect is alternately to connect the middle brush first with one and then the other of the two outside brushes. To conduct the measurement we employ a mirror galvanometer and an insulated battery composed of 50 or more small secondary cells. The conductor, C, the capacity of which is to be measured, is connected to the middle brush, and the two outside brushes are connected respectively to one terminal of the battery, B, and of the galvanometer, G, the other terminals of the battery and galvanometer being connected together and to the earth. (See Fig. 3.) On setting the motor in rotation the conductor is connected alternately with the battery and galvanometer, these being charged to a known potential and then discharged through the galvanometer. The number of times per second this operation is performed is ascertained in the following manner:—On the shaft of the motor is placed an endless screw gearing in a wheel which rotates once every 100 rotations of the motor. A pin on this wheel is caused once in every 100 revolutions to move the hammer of a small gong and thus to make a sound which announces that the motor has completed 100 revolutions.

Fig. 1.



Fleming and Clinton Commutator.

Fig. 2.

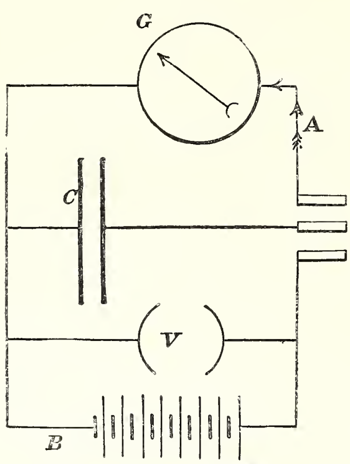


In the commutator as constructed in the instrument before you, one revolution of the motor causes four discharges to pass through the galvanometer. Hence, if we take the time

by the stop watch in which the motor makes 1,000 revolutions, or in which 4,000 discharges pass through the galvanometer, we can ascertain the number of discharges per second.

To reduce the results of observations to numerical values we have to know, first, the potential to which the conductor is charged. This may be done by measuring the difference of potential of the ends of the battery with any good form of voltmeter. The galvanometer may be calibrated by passing through it a known current from the same battery obtained by connecting in series the galvanometer, the battery, and a known high resistance. Having these data and the number of discharges per second obtained as above described, we can measure the capacity of any insulated conductor, such as a large sphere, or disc, or vertical wire, and determine the same in electrostatic units or micro-microfarads.

Fig. 3.



$A_{ma} = C_{mfd}\, VN$

Again, by the same appliance, we can determine quite easily the capacity of a Leyden jar, or of a parallel plate or condenser, or of a parallel plate condenser having between its plates a sheet of any solid dielectric. We can make use of the above-described commutator to measure the electrostatic capacity of an aerial wire, as used in wireless telegraphy, by simply connecting the insulated wire to the middle brush.

Such an insulated wire constitutes a form of Leyden jar, of which the earth is the outer coating, and the space round the wire the dielectric.

In making such a measurement, however, we have to determine the capacity of the commutator itself, and to subtract this from the total capacity as measured. Operating with this appliance, we find the capacity of a Leyden jar, which is commonly called a pint size, may be about 1/700 of a microfarad whilst the capacity of a wireless telegraph antenna 100 feet in height, constructed of a wire 1/10 of an inch in diameter, may be about 1/5000 of a microfarad.

Experiments with the commutator show that if a number of wires are hung up parallel to one another in the air, the capacity of the whole of the wires taken together is much less than the sum of each of them taken individually when the others are removed.

Our attention must next be directed to the measurement of a quantity, called the inductance of a circuit. When an electromotive force is applied to a circuit, the current does not instantly appear at its full value. Time is required to create a current in a conductor by a finite electromotive force, just as time is required to create velocity in a mass of matter by mechanical force.

The quality of the circuit, however, on which this fact depends is called its inductance, and it corresponds to inertia in matter. The value of the inductance of a circuit can be calculated for certain simple cases, just as the capacity can be determined. If the wire is not made of magnetic material the inductance depends only on the size and shape of the wire, and is measured for our present purposes in centimetres or in larger units called microhenrys, each of which corresponds to 1,000 centimetres.

The mathematical processes by which these calculations can be made are somewhat complex, but in Table II. below are given the values of the inductance L for a number of cases with which we are concerned in practice, such as a straight wire of length l and diameter d, the same wire bent into a circle of perimeter l or into a square of perimeter l, or into a rectangle, the sides of which are respectively a and b.

TABLE II.

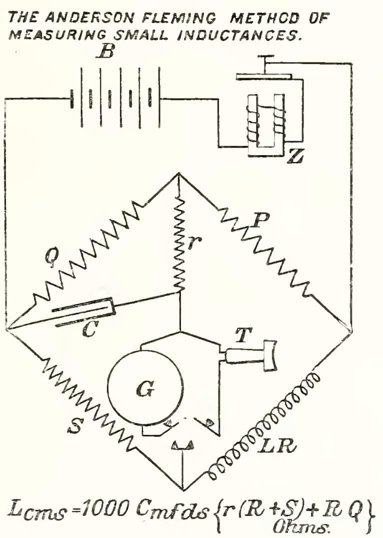
Inductance of Various Standard Forms of Circuit.

Straight wire ..	$= L = 2l\ (2{\cdot}303 \log_{10} 4l/d - 1)$ cms.
Circular wire ..	$= L = 2l\ (2{\cdot}303 \log_{10} 4l/d - 2{\cdot}45)$
Square wire ..	$= L = 2l\ (2{\cdot}303 \log_{10} 4l/d - 2{\cdot}85)$
Two parallel wires	$= L = 2l\ (2{\cdot}303 \log 2D/d)$
Rectangle.. ..	$= L = 4\ [(a + b) \log_\epsilon \frac{4ab}{d} - a \log_\epsilon (a + \sqrt{a^2 + b^2}) - b \log_\epsilon (b + \sqrt{a^2 + b^2}) + 2\sqrt{a^2 + b^2} - 2(a + b)]$

We have in the next place to notice a special characteristic to high frequency currents, viz., that the current is entirely on the surface of the conductor. An experimental proof of this is given in a later lecture.

The formula in the above Table II. give us the inductance for infinite frequency, or when the current is wholly upon the surface of the wire. They need a slight but unimportant correction when we are dealing with currents of finite frequency such as a million per second. In general, the only method of determining the inductance of a circuit is to do it experimentally. One of the most convenient means of carrying out this measurement is by a bridge measurement suggested by Professor Anderson and modified by myself. In this method we

Fig. 4.



make the conductor, the inductance of which is to be determined, one arm of a Wheatstone's bridge and complete the circuit as shown in Fig. 4. A variable resistance r is placed in series with the galvanometer and a condenser C connected between one terminal of the bridge and of the galvanometer. In the circuit of the battery is placed a buzzer or electromagnetic interpreter, Z, which breaks and makes the circuit of the battery very rapidly, say, from 200 to 300 times per second, and a telephone, T, is placed in the bridge circuit, which can be substituted for the galvanometer, G, when required. The first step is to balance the bridge for steady currents.

This is done by employing the galvanometer in the bridge circuit, and stopping the buzzer. When the measuring arm of the bridge has been so adjusted that the galvanometer shows no current, the battery key being held down, we know that the relation which holds good between the four arms of the bridge, P, Q, R, and S is that $P/Q = R/S$. We then set the buzzer in operation, and substitute the telephone for the galvanometer, and alter the value of the resistance r in series with the galvanometer until the telephone yields no sound. If then C is the capacity in the bridge reckoned in microfarads the inductance L in centimetres of the conductor being tested is given by the formula :—

$$L = 1{,}000\ C \left\{ r(R + S) + R\,Q \right\} \text{ centimetres,}$$

where C is the capacity of the condenser in microfarads, and P, Q, R, and S are the bridge arm resistances in ohms. L is the inductance of the arm of the bridge, of which the resistance is R.

In making this measurement of inductance, the capacity which must be employed in the bridge circuit has to be selected with reference to the magnitude of the inductance being measured. We may employ the method to determine the inductance of a wire bent into the form of a square, or, *vice versâ*, we may employ the known inductance of such a wire to determine the value of the capacity being used in connection with the bridge.

Another important measurement is that of the mutual inductance of two circuits. If one circuit acts inductively on another the mutual inductance M of the two circuits is measured by the electromotive force produced in the secondary circuit when a current of unit strength in the primary circuit is started or stopped uniformly in one second. If a current in a wire is steady, the fall of electric pressure, otherwise called the voltage, dropped down the wire is measured by the product of the resistance and current. If the current is rapidly varying the voltage drop is measured by the product of the inductance and the rate of change of the current. If we are dealing with alternating currents which have a uniform frequency, n, then the voltage drop due to inductance is easily shown to be equal to 6·24 times the frequency multiplied by the product of the current and the inductance. Hence if the frequency is very large, the voltage drop may be large, even if the current is small. It is easy to show this by a striking experiment.

We create an oscillatory discharge in a thick wire by sending Leyden jar discharges through it, and we find that if a small incandescent lamp is connected to two points on this

wire a few inches apart, the lamp will light up, although the actual current passing, as shown on a hot wire ammeter, may not exceed 5 or 6 amperes. If, however, we pass a continuous current of the same value through the wire, we should find that the lamp would not light up. This shows that the volt drop down a given wire produced by a high frequency alternating current may be enormously greater than that produced by a continuous current of the same effective value.

Returning then to the mutual inductance, M, of two circuits, we may define this quantity by saying that the electromotive force produced in the secondary circuit by an alternating primary current is 6·28 times the frequency multiplied by the product of the primary current and the mutual inductance, M. If we have two coils of inductance, L and N, which form primary and secondary circuits of a transformer we can join them up in two ways; first, so that a current flows the same way round both coils, or secondly, we may join them up so that a current may flow in opposite currents round the two coils when these are joined in series.

It is easy to show that, in the first case, the whole inductance of the two circuits is $L + 2M + N$, and in the second case, it is $L - 2M + N$. Hence the difference of these two inductances divided by 4, gives us the value of the mutual inductance. We can, therefore, determine the mutual inductance of two circuits by making two measurements with the above described bridge and telephone, and can thus easily measure small mutual inductances.

It was mentioned just now that the principle property of high frequency currents is that they are entirely on the surface of conductors. A wooden rod, covered with the thinnest coating of gold leaf, is just as good a conductor for very high frequency currents as a solid copper one. On the other hand, the copper rod has a far higher resistance for high frequency currents than it has for steady currents. Lord Rayleigh has given a well known formula for tabulating the high frequency resistance, R', of a nearly straight conductor of length l, of which the steady resistance is R ohms, for high frequency currents of frequency n. If the metal is non-magnetic, the formula is—

$$R' = \sqrt{R \pi n l}$$

and for a round-sectioned copper wire of diameter d the above formula becomes

$$R' = R \frac{\pi d}{2} \sqrt{n}$$

where R' is the high frequency resistance, R the ordinary steady resistance, and l is the length of the conductor. We find, then, that for high frequencies, the value of R' is very different from R. Thus, for instance, with a frequency 10^6 and a diameter of 1 centimetre, R' is nearly 40 R. On the other hand, if $d = 1/40$ centimetre, which is the size of a No. 36 S.W.G., then for the same frequency $R' = R$.

It is important to notice that the above formula only applies to straight or nearly straight wires, but not to closely-wound spirals, because, in the latter case, there is a displacement of the cylindrical distribution of the current over the cross section, which results in the production of eddy currents in the metal.

Accordingly, in making high-frequency circuits, all the conductors should be made of very thin strips of metal or of fine silk-covered wires bunched together, and then the value of the high-frequency resistance is known, and is equal to that of the ordinary or steady resistance.

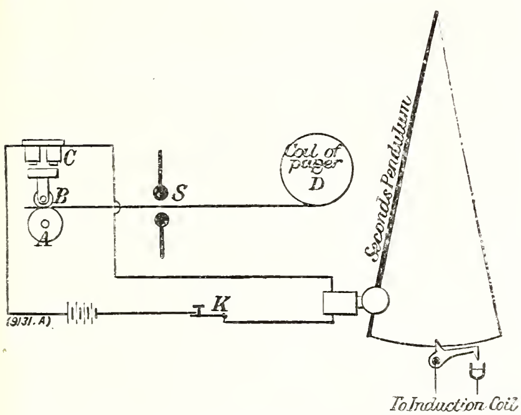
Another measurement of considerable importance is that of a spark resistance. The usual mode of producing a high-frequeucy current, as explained in my previous courses of lectures, is by the oscillatory discharge of a condenser. To the secondary terminals of the induction coil we attach one terminal of a condenser, which may consist of a battery of Leyden jars; the one coating of this condenser is attached to one terminal of the induction coil, and the other coating is attached to the other spark ball through an inductance coil. We have thus in series a spark gap, a condenser, and an inductance coil, and when the latter is put into operation, we have an oscillatory spark at the spárk gap, and trains of electric oscillations in the inductance coil. If we insert in series with this condenser an ammeter suitable for measuring high frequency currents, as described in the next lecture, we can by this means determine the effective value of the current in the oscillatory circuit. Again, if we know the length of the spark gap, we can determine the potential to which the condenser is charged, and if we know the capacity of this condenser we know the energy stored up in it.

If then we can determine the number of sparks per second, we can tell the power in watts given to the condenser, because

this latter is equal to $\frac{1}{2} N \frac{C}{10^6} V^2$ where N is the number of discharges per second, C is the capacity in microfarads, and V the charging potential in volts, the resulting power being given in watts.

Suppose we assume that the inductance coil has no sensible resistance, then the whole resistance of the circuit is concentrated in the spark gap, and its resistance in ohms is given by the quotient of the power put into the condenser by the square of the current in amperes flowing in the condenser circuit. The measurement of the spark gap resistance therefore can be effected if we can determine the number of oscillatory sparks per second.

FIG. 5.



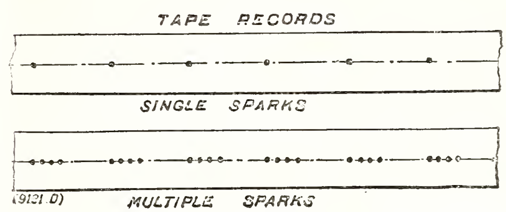
SPARK COUNTER. (FLEMING).

I have lately devoted particular attention to the construction of an instrument intended to effect this measurement. The instrument is constructed in the following manner:—A small electric motor has a flanged pulley put upon its shaft over which lies loosely a strip of telegraph paper tape, the pulley being just wide enough to allow the paper to lie on it. Over the pulley of the motor rests another pulley, called a jockey pulley, carried at the end of a long, weighted rod, which is upheld by an electromagnet. As long as the jockey pulley is held up, the paper tape will not travel when the motor revolves, but when the jockey pulley is dropped the paper is gripped and travels with a speed determined by the speed of the motor. This paper tape is made to pass in part of its course between two spark balls, and at every oscillatory spark it is pierced with a hole. The primary circuit of the induction coil contains a switch which can be closed by an electromagnet. This electromagnet is operated by a pendulum (see Fig. 5) so arranged that when the pendulum takes one swing, occupying a period of one second, it breaks an electric circuit and then makes it again for exactly one second, and this interruption is caused to drop the jockey pulley on to the motor pulley for one second, and at the same time to close the induction coil circuit also for one second.

When the operation is over we find, therefore, that the paper tape is perforated with a number of holes which correspond to the number of sparks per second, that is, to the number of oscillatory discharges (see Fig. 6). Accordingly we have the means of reckoning the value of the letter N in the above formula.

We have already seen how the capacity of the Leyden jar can be measured, and in the next lecture figures will be given to you showing the manner in which the charging voltage can be estimated from the length of the spark gap. By means of this spark counter we are

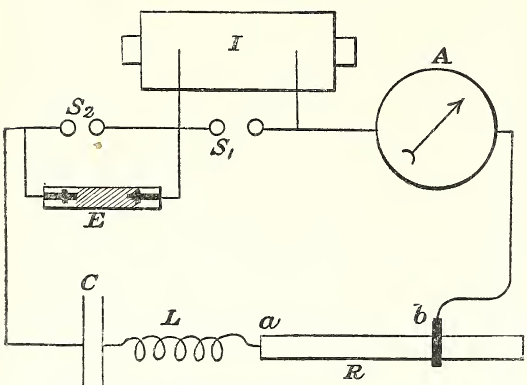
FIG. 6.



enabled to estimate the power put into the condenser, and from the measured value of the current in the oscillatory circuit we can determine the spark gap resistance. This spark gap resistance is found to be a function of many quantities. It depends first upon the length of the spark, increasing very rapidly with the length. In the second place, it varies with the quantity of electricity stored in the condenser and released at each discharge, the spark gap resistance decreasing with increasing discharge current. In the next place, it depends somewhat on the inductance of the circuit, and upon the frequency of the sparks, moreover a careful examination of the subject of the spark gap resistance, shows that the resistance of the spark is not constant over the whole operation of the spark, but increases towards the end of the discharge as the oscillations die away in amplitude. We cannot therefore speak of any particular length of spark as having a fixed resistance. A spark of 5 milliamperes in length may have a resistance of 5 or 10 ohms or it may have a resistance of very much less depending upon the quantity of the discharge.

Professor Slaby, of Berlin, has made some interesting experiments on spark resistance by the following method:—He places in series with one another two spark gaps, S_1 and S_2 (see Fig. 7). Across one spark gap are joined the secondary terminals of an induction coil and the other spark gap is short circuited by a tube, E, containing the solution of sulphate of copper, which has a resistance of about 410 ohms. The circuit is completed by a condenser, O, a variable inductance L, and a hot wire ammeter A, suitable for measuring high frequency currents and also a variable carbon resistance R. An experiment was conducted in the following manner:—The spark balls across which the induction coil terminals were connected will be called the main spark, the other spark gaps shunted by the tube of sulphate of copper will be called the spark gap under investigation. This last spark gap could have its length

Fig 7.



Slaby's Method of Measuring Spark Resistance.

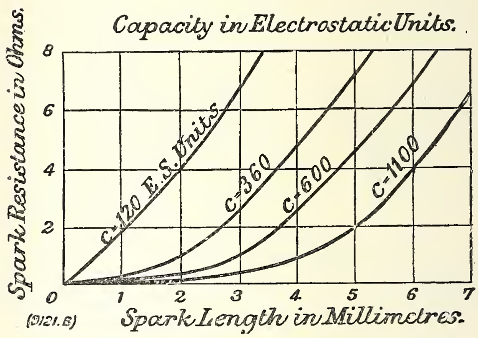
varied and measured by means of a micrometer. The first measurement consisted in closing this last spark gap entirely, and then varying the amount of resistance inserted by the carbon rheostat, whilst at the same time observing the value of the current as read on the hot wire ammeter. In this manner a curve could be plotted showing the variation of current with resistance in the oscillatory circuit. In the next place the carbon rheostat was cut out and the length of the spark gap under observation was varied, whilst at the same time the readings of the hot wire ammeter were taken corresponding to observed spark gaps. From these two observations a curve could be set out showing the spark resistance in terms of the spark length.

Some of these observations by Professor Slaby are given in the following table, and plotted out on the curves in Fig. 8:—

TABLE III.—Measurement of Spark Resistances. (Slaby.)

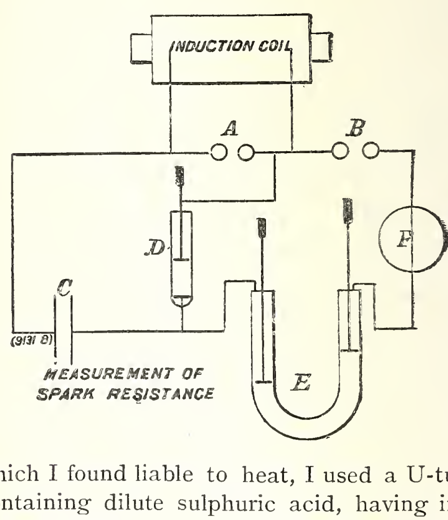
Spark length in m.m.	Spark Resistance in Ohms for various Capacities C in Electrostatic Units in the Circuit.			
	C = 120	C = 360	C = 600	C = 1,100
1 m.m.	2 ohms	0·4	—	—
2 ,,	4 ,,	1·0	0·25	—
3 ,,	7 ,,	2·7	1·0	0·4
4 ,,	—	5·0	2·5	0·8
5 ,,	—	7·5	5·0	2·0
6 ,,	—	—	7·2	4·2
7 ,,	—	—	—	6·5

Fig. 8.



I have repeated Slaby's observations in the Pender Electrical Laboratory of University College, London, with some slight modifications. In place of the carbon rheostat

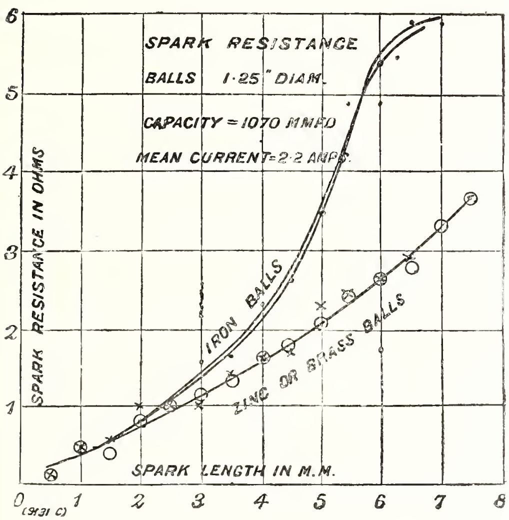
Fig. 9.



which I found liable to heat, I used a U-tube containing dilute sulphuric acid, having in it two moveable pistons, by means of which the length of the column of sulphuric acid in it could

be varied (see Fig. 9). A thermometer, placed in this tube, served to give the temperature, and from the known resistivity it was possible to estimate the resistance for any position of the pistons. In place of short circuiting the spark gap by a tube of sulphate of copper I employed an inductance coil, and so arranged the ammeter that it measured only the current passing through the spark to be measured. These experiments were made with spark balls of different materials, and it was found that for lengths of spark gap, greater than two millimetres, there was a very decided difference between the resistance of sparks taken between iron balls and those between brass or zinc balls of about three centimetres in diameter (see Fig. 10). For spark lengths of about five

Fig. 10.



or six millimetres the resistances of spark between iron balls is nearly double that between zinc balls of the same size; this is no doubt connected with the greater infusibility of iron.

Further experiments on spark gap resistance have recently been made by Rempp. He employed rather long spark gaps, and took a spark between zinc balls varying in diameter from one and a-half to five centimetres. His results show that the spark resistance has a minimum value corresponding to a spark length of about four or five millimetres, the spark resistance increasing for shorter spark lengths, and also for longer spark lengths (see Figs. 11 and 12). Rempp confirmed the observations of Slaby and also my own, which show that in proportion as the capacity in the oscillating circuit is greater, so the spark resistance for a given spark length is smaller. The smallest spark length by Rempp was about half an ohm when using a capacity somewhere near 7,000 m.mfds.

By means of the spark counter above described, I have made some intersting researches lately on the phenomena of the spark when using an alternative current transformer instead of an induction coil. Employing a transformer worked with an alternator having a frequency of about 50, I find that so far from there

Fig. 11.

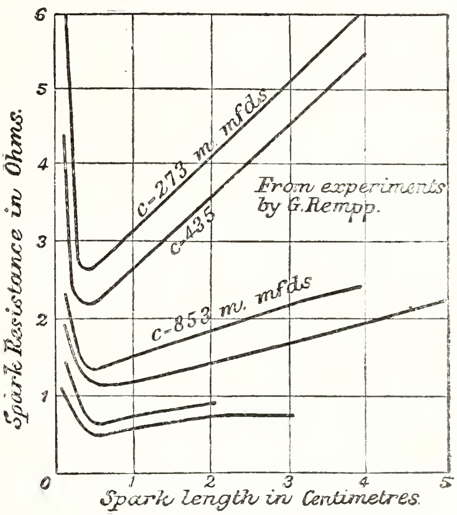
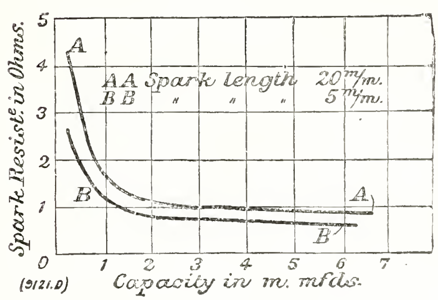


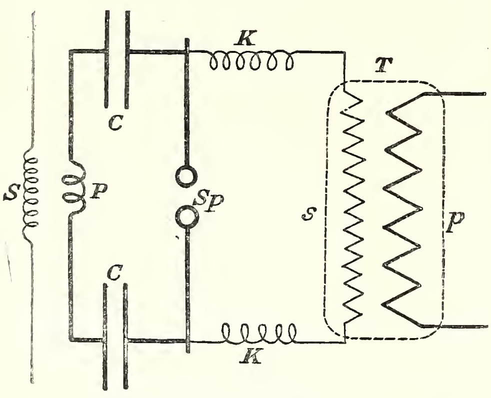
Fig. 12.



being a spark for alternation, as might naturally be supposed, in some cases there were far fewer than 50 sparks per second, and in some cases a far greater number. When employing very short spark gaps, I found it was necessary to insert inductance in between the spark gap and the transformer, in order to destroy the alternating current arc that would otherwise form and enable the condenser to become charged (see Fig. 13). Under these circumstances, it is found that the oscillatory discharges sometimes rose to as many as 500 per second.

The explanation of this anomaly is as follows:—When an alternating current transformer is employed to charge a condenser placed in series with an inductance coil as a shunt across a spark gap, the interval between the spark balls is occupied not only by a condenser discharge, but by a true alternating current arc, and unless this arc is quenched at each alternation, the condenser cannot become charged again. The simplest way to quench this arc is to insert inductance between the spark balls and the transformer. This inductance, however, causes a drop in voltage when a current is taken out of the transformer. Consider then the instant before discharge. The transformer gives a certain

FIG. 13.



Transformer Plant for creating Electric Oscillations

voltage, the condenser is charged to that voltage, and if that voltage exceeds the voltage corresponding to the spark gap length, a discharge commences. At this moment, however, the voltage drops in consequence of the inductance inserted between the transformer and spark balls. The discharge then ceases, but it immediately commences again, and in this manner five or six discharges in the same direction may take place during one semi-period of the transformer current. On the other hand, if the condenser capacity is very large, and if the spark gap is long, it may require a time equal to several complete periods of the transformer current before the potential difference of the spark balls rises to a value which will cause a discharge to take place. It, therefore, follows that great errors may be committed if, in estimating the power put into the condenser, we always assume that the number of periods of the condenser is equal to the number of alternations in the alternating current; it may be much fewer and it may be much greater with corresponding difference in the resistance of the spark.

IRISH EDUCATION.

In the *Journal* of February 24, 1905, attention was directed to the Seventieth Report of the Commissioners of National Education in Ireland, and the tendency of education to become almost entirely sectarian in the Irish primary or national schools was noted. This tendency is not less noticeable in the Tables attached to the Seventy-first Report of the Commissioners, just issued. The percentage of schools having Roman Catholic and Protestant pupils in attendance was in 1893 45·5, in 1903 it had fallen to 33·1, and for 1904 there was further decrease to 32·5. There were in Ireland last year 2,802 schools attended by pupils of both denominations, but of these 1,934 were under Roman Catholic teachers exclusively, only 5·4 per cent. of the pupils being Protestants. The remaining 868 schools were under Protestant teachers, and the percentage of Roman Catholic pupils was 8·9. There were only 30 schools under Roman Catholic and Protestant teachers conjointly, and the attendance was 29·8 per cent. Protestant and 70·2 Roman Catholic. The following Table is instructive:—

Religious denominations.	Clerical. No. of managers	Clerical. No. of schools.	Lay. No. of managers	Lay. No. of schools.
Roman Catholic	1,165	5,772	143	175
Late Established Church	708	1,054	253	417
Presbyterian	386	685	168	231
Methodist	62	89	11	15
Other denominations	10	13	31	36

These figures show that there are 5,947 Roman Catholic national schools in Ireland, and of these 5,722 are under priest managers and only 175 under lay managers. With the Protestants the lay element is much stronger. There are 2,540 non-Roman Catholic national schools, and of these 1,841 are under clergymen managers and 699 under lay managers. There are 34 Roman Catholic priest managers to every one lay manager, whereas the Protestant clerical managers are less than 3 to 1. The religious denominations of the pupils on the rolls of the national schools on the 31st December, 1904—730,417 in all—were as follows:—Roman Catholics, 74·2 per cent.; Episcopalians, 12·1 per cent.; Presbyterians, 11·5 per cent.; Methodists, 1·3 per cent.; other denominations, 0·9 per cent. It is curious that these percentages are in all cases identical with the figures

given by the Commissioners in their seventieth report for 1903. The average daily attendance at the schools as compared with the number of pupils on the rolls remains low, although it shows a slight improvement on the figures of last year, being 483,897 as compared with 482,489. The percentage has risen to 65·7, being the highest recorded. In 1903 it was 65·0.

In 1900 it was determined (as a result of the recommendations of the Commission on Manual and Practical Instruction) to remodel the curriculum of the national schools and to add to the course several new subjects. It was also decided to try the new system of organisation in the case of several subjects already included in the curriculum which were either ineffectively taught, or were attempted in only a comparatively small number of schools. The subjects included in the organisation were needlework, vocal music, cookery and laundry work, manual instruction and drawing, and elementary science. Some of the subjects required little apparatus and that of an inexpensive kind, whilst for others a considerable and comparatively expensive equipment was necessary. But Ireland depends mainly on the General Exchequer for the furtherance of education. Very little local effort has ever been made to supply anything more than the absolutely necessary apparatus for school purposes, and consequently subjects requiring much local outlay have generally remained unattempted. Needlework is popular, but progress is greatly hampered by irregular attendance. Manual instruction and elementary science have not the advantage of popularity, and funds were lacking for the necessary apparatus, but liberal equipment grants have now been made. Instruction in cookery has suffered even more than instruction in manual training and science, no assistance being given to provide pots and pans and other kitchen utensils. Lack of funds has also checked the progress of laundry work. The greatest progress has been in the case of vocal music. A return attached to the report shows that the number of schools teaching vocal music has increased from 1,475 in 1899 to 6,683 in 1904; the schools in which drawing is taught have increased from 2,146 to 8,614 in the same period; the increase in cookery has only been from 125 to 362. It is noticeable that whilst in 1889 French was only taught in 105 schools, in 1904 it was taught in 1,983.

In their 1904 report the Commissioners made some very strong remarks upon the wretched condition of a large number of the school houses. They repeat them in the present report. "We wish again," they write, "to point out that the existing plans of school houses are antiquated, that the scales of grants are admittedly insufficient, and that it is sheer waste of public money to erect buildings which are condemned by all experts as unsuitable for the purpose for which they are provided. . . . We are aware that our proposals involve a very large increase in the annual expenditure on primary education, and that, as the Treasury have pointed out, many of the proposed changes relate to matters for which the rates in Great Britain are responsible. But what we have to consider are the requirements of education, prescinding from the source from which these requirements may be met. It seems to us to be involved in the Legislative Union, and to be a necessary consequence of the identity of taxation in Great Britain and Ireland, that the Irish child should enjoy equal advantages, so far as education is concerned, with children in English and Scotch schools." It seems that the major part of the development grant is hypothecated for land purchase, and cannot bear a further considerable charge for education. The Commissioners point out that "the Development Grant is equivalent to a sum of money voted by Parliament for the relief of the education rates in Great Britain, and it follows that since such a grant was required in Great Britain it is far more indispensable in a poor country like Ireland, where it is impossible to obtain from local sources financial provision for the maintenance of schools." The Commissioners wish to place on record their conviction that "the expenditure on the erection and reconstruction of school houses cannot be discontinued in the near future without injurious results, which will be increasingly apparent with every succeeding year."

GLEANINGS FROM THE UNITED STATES' RAILWAY RETURNS.

The latest publication on the subject of the United States' railways which can be consulted in any London reference library, is the report of the Interstate Commerce Commission for 1903. The whole report is replete with interesting information, from which the following notes have been compiled:—

Mileage Open.—The total working mileage open increased by 5,500 miles over that open twelve months previously, on June 30, 1902, and amounted to an aggregate of 207,977 miles. Apportioned in relation to population and area this gives 26·03 miles of line per 10,000 inhabitants, and 7,000 miles of line per 100 square miles of territory. The total mileage, including double tracks and sidings, amounted to 283,821 miles. The greatest railway density in relation to area is in the state of New Jersey, where the route mileage is 30·17 per 100 square miles, Massachusetts ranking next with 26·39 route miles. In the sparsely populated States the relation of route mileage to inhabitants is a large one; for instance, Nevada, which has only 0·87 miles of line per 100 square miles of area, has 213·73 miles of line per 10,000 inhabitants. At the other end of the scale is Massachusetts with 7·20 miles, and New York with 10·79 miles per 10,000 inhabitants respectively.

The railways are also classified on the basis of the operated mileage of the different companies. Of these 50 have a route mileage of over 1,000 miles, 18 operate lines varying in length between 600 and 1,000 miles, 22 lengths between 400 and 600, 31

between 250 and 400, and 1,160 have less than 250 miles under their control.

Number of Locomotives in Service.—The number of these increased by 2,646 during the 1902-03 fiscal year. The total number amounts to 43,781, of which 10,570 are classed as passenger engines, 25,444 as freight engines, 7,058 as "switching" engines (presumably used for shunting purposes in goods yards), while 799 are returned as unclassified. Reckoning per 1,000 miles of line, there were in use 214 locomotives, of which 52 were employed on passenger service, 124 on freight service, and 38 for miscellaneous duties. Each passenger locomotive carried 65,742 passengers an average distance of 30 miles apiece; each goods locomotive hauled 51,265 tons an average distance of 133 miles during the period under review.

The locomotives are also catalogued in tables, which will appeal especially to engineers, being arranged according to the number of their driving wheels, and also according to the number of their cylinders. Single expansion engines are most numerous, amounting to 40,443. These have an average tractive power of 21,156 lbs. apiece, with average heating surfaces of 1,590 square feet and grate areas of 27 square feet. The weight of these engines, excluding the tenders, is 57 tons, of which 46 tons is carried on the driving wheels. Compound engines are fewer in number, and are divided into the two classes of four-cylinder and two-cylinder compounds. The former are the more numerous, amounting to 1,953. They have an average tractive power of 30,551 pounds, an average grate surface of 50 square feet, and a heating surface of 2,702 square feet. Their average weight is 99 tons, of which 70 tons is the weight on the driving wheels. The two-cylinder compound engines number 849, their tractive power averages 31,379 pounds, the average grate surface 37 square feet, and the average heating surface is 2,551 square feet. These engines weigh less than the four cylinder compounds, the weight exclusive of the tender being 82 tons, and the weight on the driving wheels 68 tons.

Cars Used for the Passenger Service.—These amount to 38,140. Reckoned per mile of line operated they amount to 186. In regard to the number of passengers carried, there were 55 cars available for each 1,000,000 passengers who travelled by the trains. A division of the cars among their classes would show that 18,090 were graded as first class cars, 3,602 as second class cars, 4,837 as combination cars, 222 as emigrant cars, 537 as dining cars, 534 as parlour cars, 421 as sleeping cars. For baggage express and postal services 8,945 cars were used, and 952 cars for unspecified purposes are returned as "other cars." Practically all the cars used for passenger service are fitted with train brakes and automatic coupling devices, only 346 being without the former, and 572 without the latter.

Cars Used for Freight Service.—The total number of freight cars was 1,650,615, or an average of 8,055 per mile of line operated, having an average capacity of 29 short tons each. These are classed under the headings of box cars (which number 765,820), flat cars (which number 154,074), stock cars (which number 61,790), coal cars (which number 595,963), tank cars (which number 4,421), refrigerator cars (which number 21,454), and other cars (which account for the balance of 47,093). Of these the tank cars have the greatest average carrying capacity which is 35 short tons, and close behind these come the coal cars which have an average capacity of 33 short tons. Train brakes are fitted to 1,352,123 freight cars, and 1,632,330 freight cars have automatic couplers.

Cars Used for Companies' Services.—Every railway throughout the world has certain rolling stock used for its special needs, such as for break-down work, conveyance of coal, or cylinders of compressed gas for train lighting, or ballast, sleepers, rails, &c. In the United States 61,467 cars allocated to these special services, and are classed as officers' and pay cars (numbering 648), gravel cars (numbering 14,267), derrick cars (numbering 1,263), caboose* cars numbering 20,606. There are also 24,683 vehicles classed as other road cars. Companies' service vehicles are mostly (58,016) fitted with automatic couplings. Train brakes are only fitted to 29,196 of these cars.

AUSTRALIAN IRON.†

The successful establishment of the iron manufacturing industry in their midst has long been the cherished desire of the Australian people, and its realisation has been brought within measurable distance by the contract entered into by the Eskbank Iron Works, near Lithgow, with the New South Wales Government for the supply of all steel and iron reqnired for State purposes during the next seven years. Although there are extensive deposits —frequently of great richness—of iron distributed throughout the Commonwealth, the use of the metal was unknown to the aboriginals, who were content with tools and implements fashioned from wood or stone. The existence of iron ores of various kinds was ascertained in the early days of the Mother State, but nothing was done for many years in the way of utilising them; yet the deposits have been officially estimated as containing 59,317,000 tons of ore. The chief deposits are at Carcoar, where they are estimated to contain 3,100,000 tons, and at Cadia, where the quantity is set down at 39,000,000 tons; the ores in the former locality containing a rather high percentage of phosphorous, while at Cadia the product is impregnated with sulphur and copper. At present the only works in the Commonwealth for the manufacture

* The virtual equivalent of guards' and brake vans.

† Communicated by Mr. John Plummer, of Sydney, New South Wales.

of iron from the ore are situated at Eskbank, near Lithgow, in New South Wales, where red siliceous ores, averaging 22 per cent., and brown hematite, yielding 50 per cent. metallic iron, have been successfully treated. Abundance of coal and limestone are found in the neighbourhood. Recently considerable quantities of iron ore have been raised from the deposits situated in the Marulan, Picton, and Carcoar districts, and despatched to the smelting works at Dapto and Cockle Creek, where they have been used as flux, the gold contents of the ore helping to defray the extra cost of railway carriage. The total raised in 1903 was 22,120 tons, valued at £15,834, and up to the end of that year 63,478 tons, valued at £49,422, has been obtained. A considerable quantity of iron oxide is also raised each year, and used for flux, while there is also an export, usually of small dimensions, but amounting in 1903 to 1,193 tons, valued at £1,181. In Queensland, the principal deposits occur in the Northumberland and other islands between Rockhampton and Bowen, at Mount Lucy in the Herberton district, at the Iron Mountain in the Kangaroo Hills, and at Mount Leviathan in the Cloncurry district. During 1903, 9,808 tons of ore, valued at £3,852, were raised chiefly in the Herberton district, for use as a flux in smelting. Large deposits are found in South Australia, the most important being those at the Iron Knob and Iron Monarch Mines, situated about forty miles west of Port Augusta. The ore contents of the Iron Monarch are estimated to be 20,000,000 tons. In 1903, 33,359 tons were obtained from the deposits at Iron Knob, and used in the Broken Hill Proprietary Company's reduction works at Port Pirie. In Tasmania, notwithstanding the huge deposit of iron ore at the Blythe River, the production has not been great, and in 1903 only 9,320 tons, valued at £3,300 were raised, the greater portion of which was shipped to New South Wales for fluxing purposes. During 1901, the deposit was tested by tunnelling, and found to maintain its size and quality, and it is estimated to contain 17,000,000 tons of ore. It was proposed to ship the ore to Sydney, and smelt it somewhere on the seaboard; but the contract with the Eskbank Works to manufacture steel and iron principally from local ores has prevented the realisation of the project. The deposits in Western Australia are widely distributed, the most important being those in the watershed of the Murchison River; but, owing to their geographical position, they are, at present practically valueless; the only iron raised being for smelting purposes, the production in 1903 being 220 tons, value £88. The various engineering, galvanised iron works, iron works, and foundries in the Commonwealth in 1903, employed a total of 16,636 hands. This does not include those in other establishments in which metal industries are carried on. As showing the possibilities of a local iron manufacturing industry, it may be mentioned that during 1903 the imports of iron and steel into the Commonwealth amounted to 3,087,917 cwt., valued at £1,430,006.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in September and October, 1905 :—

New Charts.—3510—Scotland, west coast :—Inverie bay and approach. 3509—Germany :—Mouths of the Ems. 3446—Mediterranean, Ægean sea :—Paspargo islet to Samos strait. 3512—West Indies : Cuba, north coast :—Bahia Honda. 3528—Chile :—Port Lebu. 3539—Central America, west coast :—Brito road. 3520—British Columbia : Vancouver island :—Active pass. 3530—Gulf of Aden :—Berbera. 3508—Bay of Bengal :—Mayu river. 3518—Bay of Bengal :—Bentinck sound. 3525—Borneo island, west coast :— Jesselton harbour. 1220—China sea : Borneo island :—Mitford harbour. 3515—Philippine islands : Luzon island :—Santa Cruz harbour. 3474 — China, east coast :— Mirs bay. 372—Japan :—Kagosima Kaiwan. Plans :—Sakura sima seto. Hamanoichi road. Makurazaki wan. Odomari wan. 3514—Japan : Kiusiu, north coast :—Karatsu wan. 3507—Japan :—Mororan ko. 2672—Japan :—Hakodate ko. 3154—Japan :—Ominase to Gogo shima. 3531—Tasmania, west coast :—Entrance to Macquarie harbour. 5519—New Britain, &c. : Duke of York group :—Miako harbour. 3500—New Zealand : North island, east coast :—Cape Runaway to Gable end Foreland. 179 — New Hebrides : Espiritu Santo island :—Turtle and Pallikulo bays and approaches. 1923*a*—British Columbia : Cape Caution to port Simpson, &c. Plan added :—Kemano bay. 3145—Bay of Bengal :—Andaman islands. Plan added :—Eastern entrance to the Andaman or Middle strait. 55 — New Britain, anchorages in. New plan : — Unter Kambeira. 1416—New Guinea : — Anchorages on the north-west coast. New plan : — Fak Fak and Acha Tuning roads. 1101—Pacific ocean :—Mariana or Ladrones islands. New plan :—Guam or Guajan island.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners :—

1446—Scotland, east coast :—Aberdeen. 1121—Norway :—Bergen. 2369—Germany, north coast, sheet V. :—Bischöft to Brüster ört. 77—Spain, north and west coast :—Bay of Gijon. 2231—Black sea, sheet II. :—Cape Kaliakra to Odessa. 3335—Labrador :—Approach to strait of Belle isle. 779—Labrador :—Belle isle strait. 282—Newfoundlaud : —St. John's bay to Orange bay. 284—Newfoundland :—Cow head harbour to St. Geneviève bay. 266—East coast of United States :—Great Egg harbour to Albemarle sound. 1296—Chile :—Plans on the coast of. 2839—United States, west coast :—Columbia river. 2111—Borneo island, sheet VII. :—Nosong point to Ambong bay. 2636—Philippine islands :—Strait of Makassar, north part. 1760—China :—The Brothers to Ocksen islands. 2409—

China, east coast:—West coast of Formosa, &c. 532—Japan:—Simonoseki strait. 132—Japan:—Channels between Misima Nada and Bingo Nada. 2411—New Zealand:—Otago harbour. 1103—Pacific ocean:—Palao or Pelew islands, &c. 980—Pacific ocean:—Caroline islands. 2169—Pacific Ocean:—Islands in the north Pacific.

These charts are issued by Mr. J. D. Potter, 145, Minories.

HOME INDUSTRIES.

Electrification of Railway Contracts.—Reference was made last week in the *Journal* to the contract given to a German firm for the electrification of a portion of the London, Brighton, and South Coast Railway's system, and it was observed that it was reasonable to assume that the successful tender was "substantially lower, and more advantageous to the company in other ways," than any home tender. This inference would seem to be supported by observations made at the annual general meeting of the British Westinghouse Electric and Manufacturing Company, Limited, held on December 18. Referring to the company's failure to get the contract, the Chairman observed that "he was in no manner criticising the action of the railway company, which had both right and custom in its favour." The German company got the contract because it offered terms "heretofore unheard of in large undertakings." "Foreign companies," said another director, "came into this country backed by enormous capital, and buttressed by the cartel arrangements, one feature of which was that a combination of electrical manufacturers in Germany guaranteed to those of their members who competed outside Germany the difference between the low prices they had to take in Great Britain and the prices they could get in Germany." And the speaker went on to say, "If Germans like to take part in such wild cat enterprises, and prices, let them." According to the General Manager of the railway company, the Germans got the contract because they were "cheaper, and obliging." There is complaint again that the Electric Underground Railways Company (Limited) has ordered 150 steel railway cars from an American company.

Curious Steel Statistics.—In Australia, American railway plant is generally preferred, and the Government of New South Wales has just ordered from the United States Steel Corporation, 6,000 tons of plant. And yet the United States are said to be actually importing steel rails from Europe for home use. One American railway system has already contracted for 35,000 tons of steel rail abroad, and it is said that further substantial orders are to be placed for additional supplies from the same source. According to the same authority, a contract for 21,000 tons was closed in November with a Spanish firm, the whole to be delivered by the end of January. Here we have the United States purchasing steel rails at a distance of several thousand of miles from the source of supply whilst exporting steel rails many thousand of miles to Australia.

Cheese and Butter Imports.—It is noteworthy that in his report, Secretary Gilbert, of the Utica Board, says, "We no longer depend upon foreign countries for our market in cheese and butter, and their quotations have no great influence on prices there. It was not many years ago when the Liverpool cable made the price of dairy products in every American market. To-day the American people take all our cheese and butter at better prices than are paid abroad, and the prospect is that the home demand will keep up to the production for some time to come." On the other hand the American Consul-General at Singapore expresses the opinion that the time is near when American production will exceed the demand for home consumption. The American manufacturers will then have to look ahead, and it is a little surprising to find the Consul-General doubtful as to the result. "One cannot enter these markets," he writes, "and capture them immediately. It takes time and hard work, and if our manufacturers do not awaken to this fact, they will find the English and Germans, especially the latter, so strongly entrenched, when they do want a share of the trade, that it will cost much money and time to get a share. Five or six manufacturers, whose lines do not conflict, can and ought to club together, find out men of exceptional ability and character as resident agents, assign them certain territory, guarantee salaries sufficient to induce them to come here, allow them a commission on all sales in their territory, whether made by them personally or through the mail, and protect them in every way, the same as many English and German manufacturers protect their agents. Their men are on the ground. They follow all suggestions that are made to them in regard to requirements. They say to their men: 'Tell us what your trade wants in price and style and we are prepared to furnish it.' If this American Consul-General is right, a good deal that is said about the lack of pliability on the part of British manufacturers, and of capability in those who serve them abroad, must be wide of the mark.

The Cotton Crop.—The cotton crop question continues to be the subject of lively debate. One authority maintains his forecast of $11\frac{1}{2}$ million bales; another firm, issuing a corroboration of the opinion of four of their best American correspondents, puts the crop at 10,750,000 bales; a Southern Company in close relations with cotton seed crushers say that a canvass among their friends points to 10,195,000 bales. Mr. H. C. Gorst, of Liverpool, basing his forecast on the crop movement to November 30 over a series of years says that 10,898,000 bales may be expected.

It will be seen that the estimates of these authorities vary from 10,195,000 bales to 11,500,000 bales, and it may be interesting to compare them with the official estimate in America, and to note how that estimate is arrived at.

The Official Figures.—The annual crop estimate of the Crop Reporting Board of the Bureau of Statistics of the Department of Agriculture has just been published, and it shows a total production of 10,167,818 bales. This is based on a total production of 4,860,217,358 pounds of cotton, linters—that is the product of the oil mills—not being included in this estimate. It is added that the area picked was 26,117,153 acres, a reduction of 862,399 acres, or 3·3 per cent. from the acreage estimated as planted, which showed a decrease (revised) of 14·9 per cent. from the area planted last year. The acreage harvested, and commercial crops of ten years past are given by Bradstreet, and from it the following figures are taken:—

	Acreage.	Crop.
1896	23,445,000	8,758,000
1900	24,275,000	10,383,422
1903	28,014,860	10,011,374
1904	30,053,700	13,565,885
1905	26,117,153	10,167,818

Last year was the largest acreage of any year, this year the lowest since 1900, but the 1903 crop was lower. As compared with last year there is a decrease in acres harvested of 13 per cent. and of 25 per cent. in yield. Taking the last six years, says Bradstreet, the Government estimate has been an average under-estimate of 5·5 per cent. on about 600,000 bales. Last year the under-estimate was 10·3 per cent.; in 1903, only ·3 per cent.; in 1902, 2·0 per cent.; in 1901, 9·04 per cent.; in 1900, 2·7 per cent.; and in 1899, 5·6 per cent. If the under-estimate, if any, this year amounts to the average of 600,000 bales, an actual yield of 10,767,000 bales is possible. Again, if the estimates of 500,000 bales of old crop as left over are correct, and present prices bring this out in addition to the Government figures of yield, a commercial crop of 10,667,000 bales is possible. Obviously it is still too early to measure the exact size of the crop, and later, ginning returns will be necessary before final pronouncement is possible. Bradstreet considers that a commercial crop of between 10,500,000 and 11,000,000 bales would still seem to be possible.

The Manchester Ship Canal.—The contrast between the service done to Manchester by its ship canal and the disastrous results to the shareholders of the company owning the canal is brought out in a startling way by a correspondent of *The Times*. Of course many of the Manchester men who first took up shares in the company were influenced by considerations of indirect rather then direct gain. The success of the company as a commercial undertaking was always problematical, the advantage of the canal to Manchester and the district when completed was never doubted. These expectations have been fully realised. In eleven years Manchester has become the fifth port of the United Kingdom, and it is estimated that the total sea-borne and barge traffic of the canal in 1905 will reach 4,250,000 tons. The net receipts for 1905 are estimated at £235,000, as compared with £205,459 in 1904, but the debenture interest and other charges alone require £270,000, or £35,000 more than the net receipts. Whilst much has been done to bring the port of Manchester up to the most modern requirements much remains to be done which must involve a heavy expenditure of capital. The canal has to be deepened 2 feet to 28 feet, £550,000 is to be applied to improvements and extensions, and £950,000 to the purchase of the undertakings of the Manchester Ship Canal Warehousing Company and the Manchester Dock and Warehouse Extension Company. This great but necessary additional expenditure must still further delay the time when the ordinary shareholders of the company may expect a declaration of a dividend, and it is unlikely that the preference shareholders will get anything for some years to come. They may find comfort in the reflection that for many years after its construction the Suez Canal had little but hope to offer those who owned it, but the similarity does not go much further. The Suez Canal Company, with no competition to fear, has been able to impose charges upon shipping quite impossible in the case of the Manchester Ship Canal. That great undertaking has conferred immense benefits upon South Lancashire, Yorkshire, and the Midlands, but those who have found the necessary capital are never likely to obtain more than a very small direct return as proprietors of the canal, however much some of them may be gaining indirectly.

Inland Waterways and Home Industries.—The Prime Minister's announcement that a Royal Commission is to be appointed to consider the canals problem has been received with general satisfaction. Its solution would mean a good deal to home industries, but the question is beset with difficulties. The Society of Arts has done much to revive interest in the subject, and members will recall the able paper read by Mr. Arthur Lee (*Journal*, December 2nd, 1904), and the discussion that followed, in which Sir Michael Hicks-Beach, and other authorities, indicated some of the obstacles to what may be called the restoration of canal traffic. Much is said about the immense sums spent by our Continental rivals in the improvement and extension of their canals, but it has to be remembered that whilst England does not possess those great natural waterways enjoyed by Germany and France she is better supplied with railway accommodation, and despatch is of paramount importance in this country. Great difficulties, again, are those of gauge and water, gauge differing frequently on a long journey, and water running short in the summe

months. Now many of the canals are commercially valueless, and the more important are in the hands of railway companies who, originally pressed to buy them up, have still to be persuaded that they can be made useful auxiliaries. That England would be an enormous gainer, as other countries have been, by cheapened transport by land for her industrial products, and that a better system of canals would conduce to this result, is generally admitted, but there would be great opposition to anything like the State control and ownership of all the canals at the cost of the ratepayers. Fuller powers might, however, be given to local authorities, and the Government might usefully intervene to improve certain inland waterways. Whilst France, Germany, Belgium, and Austria have spent enormous sums during the last thirty years in improving and extending their inland waterways, with excellent results, nothing of consequence has been done in this direction in England since 1825, save the Manchester Ship Canal. Ministers are slow to move unless under the pressure of public opinion, and unfortunately the canal question excites little interest in the general body of the electorate.

GENERAL NOTES.

Nobel Peace Prize.—The Board of Education have received through the Foreign Office an intimation that, in order to be eligible for the Nobel Peace Prize, which will be awarded in December, 1906, candidates must be proposed to the Nobel Committee of the Norwegian Parliament before February 1st next. The following persons alone are qualified to recommend candidates:—1. Past and present members of the Nobel Committee of the Norwegian Parliament as well as members of the advisory board of the Nobel Institute. 2. Members of the Legislatures and Governments of different countries, as well as members of the Conseil Interparlementaire. 3. Members of the International Arbitration Court at the Hague. 4. Members of the Commission of the International Peace Bureau. 5. Members of the Institute of International Law. 6. University Professors of Law and Political Science, of History and Philosophy. 7. Persons who have received the Nobel Peace Prize. The Nobel Peace Prize can be granted to an institution or an association, not only to an individual. Inquiries for further information should be addressed to the Comité Nobel du Parlement Norvégien, Drammensvei 19, Kristiania, Norway.

Power from the Victoria Falls.—It is reported that the African Concessions Syndicate has been in consultation with the leading American and Continental engineers and experts on the subject of the transmission of power from the Victoria Falls to the Witwatersrand. It is announced by Reuter's agency that these authorities have unanimously expressed the opinion that the scheme is not only quite feasible, but would be commercially successful, especially as the climate of South Africa is one of the most suitable in the world for the transmission of power. There is no ice in the rivers to interfere with the working of the turbines, and no snow to break down the transmission lines. The extreme dryness of the climate is also greatly in favour of the project. The experts consider that there is absolutely no difficulty in the way of the scheme so far as the distance of transmission is concerned. With reference to statements that the volume of water in the Falls is not sufficient to produce the necessary power, it is pointed out that even in the driest season yet experienced, there is sufficient water to produce 500,000 horse-power, while at present the Rand only consumes some 150,000 horse-power. At the Falls there is an available head of about 330 feet, and if more than 500,000 horse-power were needed it could easily be obtained by cutting a canal, 15 to 20 miles in length, to a point lower down where there would be a head of 1,000 feet, which would be sufficient to produce 1,000,000 horse-power. The construction of such a canal would present no difficulty. The beauty of the Falls would in no way suffer. By the adoption of this scheme, it is further pointed out, power could be supplied to the mines more cheaply than in any other way. The importance of this can be gathered from the fact that at present over £3,000,000 is spent annually on power on the Witwatersrand, and anything which tends to cheapen this yearly toll would necessarily have a great effect on the profits of the mines.

Carriacou.—Population is so sparse in the West Indies, outside Barbadoes, and land suitable for the growth of "ground provisions" so plentiful, that Sir R. B. Llewelyn's statement (Cd. 2684) that in Carriacou—the principal island of the Grenadines—the labourers are finding it difficult to get, or retain, ground enough to supply their wants, will be read with surprise. Twenty years ago Carriacou imported no "ground provisions," now the import is considerable. The change is due (1) to the increase of population, which proceeds at the rate of 20 per cent. in ten years, and (2) the permanent absorption of the cultivable land of the island by cocoa and nutmegs. The result, while favourable to the large landowners, is the reverse to the peasant, be he proprietor or labourer, for whereas years ago he had his provision "garden" always available for the support of himself and his family, and probably had also a small piece of pasture for his cattle, the areas thus beneficially occupied have been, or are being, absorbed by permanent cultivation, on the proceeds of which he is becoming more and more dependent. Inasmuch as this permanent cultivation does not provide continuous employment for a large number of labourers, such as cultivation of cereals does, a

situation full of possible difficulty is being created for the future. If a scheme of emigration to the neighbouring and larger island of Grenada, where there is plenty of spare and good land, could be worked out, it would be advantageous.

NORTHERN NIGERIA.—Sir F. Lugard's voluminous report on Northern Nigeria (Cd. 2684) has just been published and contains much that is interesting. The Protectorate is divided into fifteen provinces, many capitals of provinces are of considerable size, and the population of the whole Protectorate is put at something over 9,000,000, necessarily a very rough estimate. War and slave raids have played havoc with the people. Fifty years ago Barth estimated the population at from 30,000,000 to 50,000,000, and under British rule we may expect to see rapid headway. Sir F. Lugard says the general position of the slave question and the Protectorate may be said to be satisfactory. The constant slave raids which have depopulated the country and almost exterminated the people of the Kabba and Kontagora provinces have ceased throughout the length and breadth of Nigeria, but the slave trade from German Adamawen and the Benue regions towards Lagos and Southern Nigeria still exists, but is being vigorously combated. The pagan tribes who formerly feared to bring their produce to the markets lest they should be seized as slaves now know that they have redress from Government, and already the complaints of the Yerguans have led to convictions of kidnappers. From Bornu the Resident writes: "The big slave traffic which was flourishing two years ago is now almost stamped out. The passage through Bornu of caravans of raw slaves from German and French territory is no longer to be found." From Karo it is reported that "complaints in assertion of freedom by slaves are extremely rare—a discontented slave simply runs away and the remainder are content." Even allowing some opitimism on the part of the Residents there is, says Sir F. Lugard, ground for legitimate satisfaction in contrasting the present state of things in Northern Nigeria with what obtained in 1900 when the Protectorate was probably one of the worst, if not the worst of places in Afriea for slave trading, in its most barbarous and cruel forms.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 17.—"The Scientific Aspects of Voice Development." By WILLIAM A. AIKIN, M.D.

JANUARY 24.—"The Planting of Waste Lands for Profit." By DR. J. NISBET.

JANUARY 31—"The Garden City and the Cheap Cottage." By THOMAS ADAMS.

FEBRUARY 7.—"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E.

FEBRUARY 14.—"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON.

FEBRUARY 21.—

FEBRUARY 28.—"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.). SIR JOHN WOLFE-BARRY, K.C.B., LL.D., F.R.S., will preside.

Dates to be hereafter announced:—

"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.

"Submarine Signalling." By J. B. MILLET.

"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"Industrial Russia." By LUCIEN WOLF.

"The Artistic in Painting and Photography." By J. C. DOLLMAN, R.I.

"Motor Boats." By BERNARD B. REDWOOD, B.A.

"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT.

"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE.

"The Fisheries of the North Sea." By WALTER GARSTANG, M.A.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 18.—"The City of Calcutta." By CHARLES EDWARD BUCKLAND, C.I.E.

FEBRUARY 15.—"The Navigable Waterways of India." By ROBERT BURTON BUCKLEY, C.S.I., late Chief Engineer Bengal Irrigation.

MARCH 15.—"The Languages of India and the Linguistic Survey." By DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit.

APRIL 26.—"Seistan: Past and Present." By COLONEL ARTHUR HENRY MCMAHON, C.S.I., Agent to the Governor-General in Baluchistan.

MAY 24.—"The Parsis of Persia." By MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.M.'s Consul-General at Meshed.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

FEBRUARY 6.—

MARCH 6.—"Imperial Questions in the West Indies." By SIR NEVILE LUBBOCK, K.C.M.G.

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

JANUARY 30.—"Chemistry of the Painter's Palette." By J. M. THOMPSON, LL.D., F.R.S.

FEBRUARY 20.—"Illuminated Manuscripts." By H. YATES THOMPSON, F.S.A.

MARCH 20.—"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A.

APRIL 24.—"Cut Glass." By HARRY POWELL.

MAY 24.—"Basket Making." By THOMAS OKEY.

JUVENILE LECTURES.

Two lectures suitable for a Juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, 1906, at 7 o'clock, by PROFESSOR HERBERT JACKSON, on "Combustion and Flame."

LECTURE I.—JANUARY 3.—Meaning of combustion—Gain in weight during combustion—The part played by the air in combustion—Oxygen as the active constituent—The reciprocal nature of combustion — Combustion from combined oxygen — Spontaneous combustion—Combustion by processes other than oxidation.

LECTURE II.—JANUARY 10.—Nature of flame—Luminous and non-luminous flames—Sources of light in flames—Effect of inert gases—Shadows cast by flame—Light without combustion—Luminosity in gases and in solids—Solids introduced into flames—Light and heat from rapid vibrations—Noises from flames.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

SIR WILLIAM WHITE, K.C.B., F.R.S., "The Modern Warship." Five Lectures.

January 29, February 5, 12, 19, 26.

PROF. VIVIAN B. LEWES, "Fire : Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

HOWARD LECTURES.

Thursday evenings, at 8 o'clock :—

PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., "High Speed Electric Machinery, with special reference to Steam - Turbine Machines." (Three Lectures.)

LECTURE I.—JANUARY 18.—*The Problems of Electric Design as affected by Speed and rated Output.*—Economic generation of electric energy dependent on cost of prime power, on type of prime mover, and on design of electric generator—Slow-speed generators developed on Continent and in United States to suit slow-speed engines, or for coupling to water-turbines—High-speed engines developed in England to suit high-speed generators—More recently the use of motor generators and of steam-turbines has emphasized the development of new forms of generators suitable for very high speeds—Output of an electric generator dependent on iron, copper, speed, and insulation—Dependence of design on "factors of utilisation"—Conception of the "active belt"—Efficiency—Energy-losses in different parts—Ventilation—Regulation— Frequency—Commutation—Relation of surface-speed to design—Limits of design as to (1) strength of materials, (2) permissible temperature-rise, (3) sparkless commutation—Output rules—Examples of low-speed design—Examples of high-speed design.

LECTURE II.—JANUARY 25.—*Turbo-dynamos.*—The problem of commutation—Use of carbon brushes and of metal brushes—Natural and forced commutation—Peripheral speed in relation to commutation—Loading of armatures — Armature distortion—Limits of design as affected by permissible temperature-rise and by sparkless commutation under all loads—Problem of centrifugal forces as affecting dynamo design—Turbo-dynamo designs.

LECTURE III.—FEBRUARY 1.—*Turbo-alternators.*—Relation between frequency, number of poles, and revolutions per minute—Relation between frequency, surface-speed, and pole-pitch—Turbine speeds and field-magnet design — The limitations of magnet design — Balancing — Armature - design in alternators — Nature of armature reaction—Armature-design as affected by power-factor of the load—Mechanical considerations — Ventilation of turbo-alternators—Forced ventilation—Efficiency; overload possibilities; limits of design—Excitation of field-magnet system—Preference given to very low voltage of excitation—Examples of turbo-alternators.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 1...Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. Jon. Stefansson, "Iceland: Its History and Inhabitants."

London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Vivian Lewes, "Our Atmosphere and its Wonders." (Juvenile Lecture I.)

TUESDAY, JANUARY 2...Royal Institution, Albemarle-street, W., 3 p.m. Professor H. H. Turner, "Astronomy." (Juvenile Lecture III.)

WEDNESDAY, JAN. 3...SOCIETY OF ARTS, John-street, Adelphi, W.C., 7 p.m. Prof. Herbert Jackson, "Combustion and Flame." (Juvenile Lecture I.)

London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Vivian Lewes, "Our Atmosphere and its Wonders." (Juvenile Lecture II.)

United Service Institution, Whitehall, S.W., 3½ p.m.

THURSDAY, JAN. 4...Royal Institution, Albemarle-street, W., 3 p.m. Prof. H. H. Turner, "Astronomy." (Juvenile Lecture IV.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m.

FRIDAY, JAN. 5...London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Vivian Lewes, "Our Atmosphere and its Wonders." (Juvenile Lecture III.)

Geologists' Association, University College, W.C., 8 p.m. Mr. Horace W. Monckton, "The Geology of the Country around the Sogne Fjord and the Hardanger Fjord, Norway."

SATURDAY, JANUARY 6...Royal Institution, Albemarle-street, W., 3 p.m. Professor H. H. Turner, "Astronomy." (Juvenile Lecture V.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 10, 7 p.m. (Juvenile Lectures.) PROFESSOR HERBERT JACKSON, F.I.C., "Combustion and Flame." (Lecture II.)

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Mr. James P. Maginnis's Cantor Lectures on "Reservoir, Stylographic, and Fountain Pens," have been reprinted from the *Journal*, and the pamphlet (fully illustrated, price 2s. 6d.), can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, W.C.

A full list of the Cantor Lectures which have been published separately and are still on sale can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

On Wednesday evening, January 3rd, Professor Herbert Jackson, F.I.C., delivered the first lecture of his course, addressed to a juvenile audience, on "Combustion and Flame."

The lecturer dealt first with the ideas of the nature of combustion which were held before Lavoisier's generalisation in his papers in the years 1775 and 1783.

The facts that combustion is attended with increase of weight and that air is necessary for combustion had been known for many years, but their importance had been overlooked in an age when change of form was the chief change to be attended to, and change of weight was considered as of little moment. Priestley's discovery of the preparation of oxygen by heating the red oxide of mercury gave Lavoisier the fact needed to enable him to make his generalisation that combustion was the act of the combination of oxygen with the combustible bodies.

Experiments were shown to illustrate the increase of weight when iron oxidises in the air, and when sulphur burns.

The presence of oxygen in the air, and its relation by volume to the nitrogen were illustrated, and the lecturer then dealt with the nature of oxygen as the active constituent of the air. The same amount of heat is given out whether oxidation take place rapidly or slowly, but the brilliancy of combination is greater the more rapid the oxidation, and this was illustrated by the combustion of several substances in an atmosphere of oxygen.

It was pointed out that while "combustion" was conveniently restricted to the act of combination with oxygen attended with the evolution of heat and light, there were numerous examples of chemical combination in which heat and light were accompanying phenomena between other substances, and experiments with chlorine and sulphur were shown to illustrate this. As combustion is an act of chemical combination, it is only a convention to speak of a substance, *e.g.*, coal gas, burning in oxygen, since a different set of conditions would lead us to speak of oxygen as burning in coal gas, and this was illustrated

by experiments designed to show the reciprocal nature of combustion. In an atmosphere of coal gas a jet of oxygen was burnt, and oxygen was also ignited as it was being evolved from fused strontium chlorate plunged into a jar of coal gas. The effect in this case is enhanced by the crimson colour of the flame due to the strontium and strontium oxide. That oxygen in the solid form as, for example, in nitrates, chlorates, and permanganates, could be made to effect the combustion of certain substances was shown by igniting mixtures of these with such bodies as phosphorus, sugar, and glycerine. The conditions of such experiments were described, and it was pointed out that the most important condition was contact of the materials between which it was desired to bring about combination. Such contact can be ensured in various ways, but in all of them there is this in common, that a fine state of division of one at least of the reacting substances is practically a necessity. In the ordinary examples of combustion in air one of the substances, viz., the oxygen, is already in a state of extreme fineness of division. In some instances this is sufficient to bring about combustion without any direct application of external heat. Such instances are described as cases of spontaneous combustion, and attention was drawn to examples of this which are known to occur, and to which many fires have been correctly ascribed. Experiments were shown with iron and with phosphorus, in which it was explained that while these bodies were not spontaneously inflammable in their ordinary state they could be obtained in such a fine state of division that mere contact with the air was sufficient to bring about their combustion.

A fine state of division of a substance which will not catch fire ordinarily, will render it highly inflammable with the application of very little external heat. In fact, so long as a substance is capable of combining with oxygen to form moderately stable products of oxidation it is, in most cases, only a matter of mechanical arrangement to ensure that these products are formed so rapidly that the heat evolved shall raise the temperature high enough to render the phenomenon a visible one. Some further experiments on methods of obtaining close contact between combustible bodies and oxygen or its equivalents were left to be dealt with at the beginning of the second lecture on flame.

The second lecture will be delivered on Wednesday next, 10th inst., at 7 p.m.

COLONIAL SECTION.

Thursday afternoon, December 14; The Rt. Hon. Lord Strathcona and Mount Royal, G.C.M.G., in the chair.

The Chairman, in opening the proceedings, said that it was a very great pleasure to him to have the privilege of introducing to them the Hon. Rodolphe Lemieux, Solicitor-General of Canada. Mr. Lemieux was one of those known as French-Canadians. It was his (the Chairman's) great privilege and good fortune to come very closely into contact with French-Canadians more than 60 years ago. He saw very much of them indeed at that time. He was connected with a very old company, one of more than 200 years' standing—two centuries and a half—the Hudson's Bay Company. This gave him an opportunity of seeing many French-Canadians, both clergy and laity; and he would say that there were no more kindly-disposed, and no more hospitable people to be found all the world over than the French-Canadians of all classes. As to their loyalty, their attachment to Canada, and to their and our Sovereign, he could only say that he believed none could be more devoted. It was remarked by a French-Canadian 50 or 60 years ago, Sir Etienne Taché, that if need be the last shot fired in defence of the British Crown in the North American continent would be fired by a French-Canadian. There had been many men of high standing and most distinguished position, statesmen of French-Canadian origin. There was Mr. Lafontaine, Sir George Cartier, and he need not say to any there that evening, indeed he thought to any Englishman, that they had an example of one of the best statesmen in the present Premier of Canada, Sir Wilfrid Laurier.

The paper read was—

GLIMPSES OF FRENCH CANADA.

By the Hon. Rodolphe Lemieux, K.C.

I must, first of all, offer you Lord Strathcona, my sincere thanks for having kindly accepted the invitation to preside this afternoon, notwithstanding your many arduous duties, both public and private. This is only one of many evidences of the genuine interest you take in all matters concerning our country. I know that I voice the feelings of every true Canadian in saying that your long and honourable career has been devoted to the welfare of Canada, and history will record with pride the many deeds which marked the various phases of your life since you left the land of the heather as a lad in the service of the Hudson Bay Company, until the

day when our late beloved Queen bestowed upon you the dignity of a Peer of the United Kingdom. On behalf of the Canadians, whom your Lordship so worthily represents as High Commissioner in Great Britain, let me express an earnest hope that you may long be spared to enjoy an honoured old age.

It is also my duty—and an agreeable one indeed—to thank the Society of Arts for its hospitality and its cordial welcome. One must appear, under such auspices as these, fully to appreciate the unfailing courtesy of the English people.

Perhaps it is vain for one who does not speak the English language as fluently as yourselves, to read a paper before such a brilliant gathering; but you will remember that not long ago two words were added to your dictionary, and it is under the long sought for *entente cordiale* that my presumption will venture to find shelter. Again, and that quite naturally, some may ask what new features of Canadian life can be revealed after the masterly lecture given, only a few days ago, by our distinguished *littérateur*, Sir Gilbert Parker. I confess at once, that nothing can be added to the brilliant description given of our great country by that young and inspired writer, whose books and novels, of such original and lofty conception, have become famous in modern English literature. But Canada is, above all, a land of contrasts from every point of view. Just as we have a winter bracing and salubrious under its northern lights, followed by a spring of a rushing maturity, by a summer alternating with its temperate heat and its fresh breezes, and by an autumn of luxuriant foliage—so have we in Canada, from an ethnical point of view, two races—the English and the French, with each their history, their temperament, their virtues, their qualities, and shall I say their failings? Sir Gilbert Parker spoke of Canada as a whole. Will you allow me to speak of French Canada—not that I wish to dissociate my fellow-countrymen from the Canadian entity, but because it might interest you to know their history under the British *régime*—and what are their ideals? May I say that, being one of their representatives in Parliament, and being of French descent myself (my ancestors came from Normandy in the early part of the seventeenth century), I can claim to speak on their behalf? So many silly things are said and written about Canada nowadays, that I deem it the duty of a public man to dispel any false notions that are being spread abroad.

Since my arrival on this side of the Atlantic I have been asked two questions about Canada:—

I. Will the American settlers invading the Western provinces become Canadians?

II. What are the feelings of the French Canadians towards Great Britain, and do they contemplate any change in their political *status?*

To the first question, I have answered that no fear should be entertained as regards the new American settler. He belongs unquestionably to the most desirable class of emigrants. He is attracted towards Canada because he finds in our prairies better lands than in the Western States, and, without offending anyone, better laws as well. His first duty is to become a full-fledged British subject, and, having obtained his naturalisation papers, he soon becomes identified with our national life. One must bear in mind that this so-called American is not, properly speaking, a Yankee by tradition. He is himself, or his father was, an immigrant from Europe—a Swede, a Norwegian, a Pole, a Dane, a German, a Hungarian. When he crosses the boundary line he has not yet been absorbed by Americanism, and, as he settles permanently in Canada, he becomes a Canadian in the fullest sense of the word. Besides, a vast number of Canadians who emigrated to and settled in the United States are coming back to Canada.

To the second question, concerning the French Canadians, this paper will serve as an answer.

First of all, where do you find the French Canadian in Canada?—because Canada is a very large country. We can easily—there is no exaggeration in this statement—find homes in our vast Dominion for 100,000,000 inhabitants.

The French Canadians—that is to say, 80 per cent. of them—are settled in the Province of Quebec, along the shores of the St. Lawrence and its tributaries, from the peninsula of Gaspe to the county of Pontiac, on the borders of the province of Ontario.

But the French Canadian element is by no means confined to the province of Quebec. There it is chiefly centred; but one must bear in mind that there are at least one million French Canadians in both the New England and Western States, and that in Ontario as well as in the maritime provinces, they are also in very large numbers. In many counties outside of

Quebec they are the majority; they elect members, and in some of the local Legislatures they are strong enough to obtain representation in the Executive.

Might I say, as a matter of history, that a French Canadian is at home in every State of the American Union, and in every province of Canada? Not a hill, not a mountain, not a river, not a valley in North America that has not been discovered or settled by his forefathers. The pioneers of that great continent were men of my race. They were the early discoverers, and there is not a spot, according to Parkman, that has not been the scene of their adventurous yet heroic exploits. Without mentioning Canada, look at the map of the United States, and you will be amazed to read so many French names. The fur traders, the *voyageurs*, the trappers, the *coureurs des bois*, were essentially an adventurous class, fond of a wild and wandering life, and during nearly two centuries, the whole continent was their field of operation. One must bear in mind that the fur trade companies held an important place under the French domination, and that this particular trade necessitated prolonged voyages, interesting discoveries, and perilous expeditions. Charters were granted by the King of France to fur companies as far back as 1599, and they, of course, employed a multitude of hunters, trappers, and explorers who, rushing amid the wilds of the new continent, have given our history a romantic description, and not a few stirring tales of adventure. The spirit which led them to desert friends and firesides to brave the perils of the deep and the unknown, is an indication of their courage and enterprise.

Remember that the first civilised men who pierced the interior of the continent were those Frenchmen, missionaries, and *coureurs des bois*; that they penetrated amongst numerous savage tribes; that they discovered, many centuries ago, what are known to-day as the great highways of civilisation. Jacques Cartier, whose statue has recently been unveiled at St. Malo, discovered the majestic St. Lawrence river in 1534. His successors passed from the St. Lawrence through the great lakes. Let me recall a few names and a few dates. In 1609, Champlain, the founder of Quebec, discovered Lake Champlain, in 1613 the Ottawa river, and in 1615 Lake Ontario, Lake Nipissing, and Lake Huron. In 1634, Jean Nicolet discovered Lake Michigan; in 1640 Chaumonot and Brebeuf discovered Lake Erie. In 1659, Lake Superior was discovered by De Groseillers, an unknown *coureur des bois*, and it is interesting to note that the copper mines in that district were first located by a Jesuit missionary at Sault St. Marie. Under the intendant Talon, a proclamation was read at this very place, by which all the great lake region was declared to be in the future part of the Crown's domain. The importance of Sault St. Marie cannot be better illustrated than by stating that the combined transit trade of both Sault St. Marie canals—the great connecting links between the waters of Lake Superior and those of Lake Huron—far exceeds in tonnage that of the Suez Canal.

Father Marquette, whose statue stands under the dome of the Capitol at Washington, and Jolliet first sighted the waters of the Mississippi river in 1673. Father Albanel, in 1671, discovered Hudson Bay territory, and the name of Hennepin will for ever be associated with the Niagara Falls, which he discovered in 1678.

But the French explorers went further west. After having passed from the St. Lawrence to the great lakes, they went forward as if attracted by the then great lone land of the Far West. Through the innumerable intricacies of streams, lakes, and *portages*, they reached Lake Winnipeg, and thence they ascended the River Saskatchewan, and at last, from *portage* to *portage*, they planted trading posts some 2,000 miles from the then colonised parts of Canada. From the mouth of the Ottawa river, near Montreal, to Georgian Bay, can yet be seen traces of the rudimentary locks which they built in order to avoid rapids. I saw one, last summer, at Sault St. Marie, just at the entrance of the great steel plant erected by American capitalists. Near St. Anne of Montreal can be seen also the ruins of the old fort of La Découverte, where the voyageurs would receive, in the rustic little chapel, communion at the hands of the missionary, and sing the hymns to the Virgin Mary, to whose protection they confided their souls, before starting for their perilous and long journey. It is a remarkable fact that the route followed by the French *voyageurs* of those distant days is practically the same as that which is at present being surveyed by the Dominion Government, with a view of constructing the Georgian Bay Canal at some later day, thus taking advantage of the many water stretches which will connect by

a short cut the wheat fields of the West with the markets of the East.

One of the most daring amongst the French pioneers was Robert Cavelier de La Salle, who entertained the idea of finding a way to China through the lakes and rivers of Canada. He started with his companions from Montreal at a place still named Lachine. Is there anything more romantic than the history of that young Frenchman, who, accompanied by a few trappers and *coureurs des bois* in their frail canoes, conceived the plan of finding a passage across the continent from the East to the West? We all know how La Salle ended his career. But half a century later, the attempt was renewed by another daring *voyageur*. His name was Pierre Gauthier de la Verendrye. In 1731, he started with his expedition and advanced further west than any of his predecessors. He went as far as the great Rocky Mountains, and one of his sons was probably the first European who, in 1742, from the peaks of the Rockies gazed on the waters of the Pacific Ocean. He discovered Lake Winnipeg, and the Lake of the Woods, where a fort was established. He also journeyed along Red River and Assiniboine Rivers, Lakes Manitoba and Winnepegosis, and one can see to-day the ruins of the old forts which were built, and none will deny their excellent strategical importance. When, in later years, the Hudson Bay Company and the other fur companies practically took possession of those immense regions, some of their best men were found amongst the descendants of those pioneers. There had been many intermarriages between those hunters and the Indians. They became the half-breeds of Western Canada—quite a distinct race from the white population.

I have named a few of the early explorers, but their number is legion. Tonty, Dautray, Duluth, De Groseillers, the Lemoyne family, Courtemanche, Mantet, Lanoue, La Durantaye, Louvigny are, with the Jesuit and Récollet missionaries, the first white men who roamed across the North American continent, animated with an indomitable courage, and with a spirit of adventure no more to be found.

Most of these men were in the employ of the fur traders, and their wanderings, daring and heroic as they were, could not contribute much—except in so far as their discoveries added territory to the royal domain—to the permanent establishment of a French colony.

The real settlers of the country were the *habitants*, that is to say, the farmers, who, under the guidance of the missionaries and the *seigneurs*, colonised and cultivated the land. They formed the permanent population of the colony, and French Canada of to-day is, so to speak, their offspring. I have often been asked from what part of France do our ancestors come. The French Canadians can trace their ancestry chiefly to Normandy, Perche, Maine, Poitou, Anjou, Touraine, Saintonge, Angoumois, Guienne, and Gascony. Brittany did not send to Canada a large contingent, whilst southern and eastern France practically sent none. The French Canadian type of to-day is clearly a Norman type. In this, as in all other cases, the survival of the fittest has happened.

It is a base calumny to assume, as some historians have done, that the early immigrants who came to Canada were criminals discharged from the prisons of France. This statement applied to male and female immigration is equally untrue. It is, on the contrary, superabundantly established by the records of the "Conseil Souverain de Quebec," that the greatest care was taken in the selection of settlers. It is also recorded that on their arrival at Quebec, the greatest surveillance was exercised on board the ships to prevent any undesirable *colon* landing. It is a remarkable fact that every French Canadian can trace back his ancestry to the very village or commune from which he originally came. Everyone can have his genealogical tree, if he only consults the very valuable work published a few years ago by l'Abbé Tanguay, under the title of "Dictionnaire Généalogique des familles Canadiennes françaises." There are not many groups of population who can thus reconstitute their ancestry.

Now, what about the population of French Canada? Are we to be numbered amongst the decaying races? I will base my answer to that very important question on a few official statistics.

By the Census of 1901—we have in Canada a Census every decade—there was a French population of 1,649,371, 80 per cent. of which is concentrated in the province of Quebec, forming in all 30 per cent. of the whole population of the Dominion. In 1903, it is estimated that there were in Quebec 1,682,682 inhabitants. The birth-rate shows for that year the following figures:—69,419, as against 52,134 in 1902, or a birth-rate of 36·75 per thousand inhabitants. The excess of birth-rates over death-rates for the years 1901, 1902, and 1903, can be summed up as follows:—

1901	24,816
1902	27,408
1903	38,543

The largest families in Canada, as no doubt you have often been told, are to be found in the province of Quebec. Some families count as many as 15 and even 20 children. A family of 10 and 12 children is not at all uncommon. In 1890 the Quebec Legislature passed a law commonly known as "*La Loi des Pères de douze enfants*," by which a father of 12 living children could claim from the Department of Crown Lands a concession of 100 acres. In the year which followed the enactment of the law, 1,300 applications were made and registered. From one village alone came 17 applications. There was such a stream of applications during the following years that the Government felt constrained to repeal the law. Some lumber merchants were speculating with the 100 acres. They quite often purchased from the applicant, and that for a paltry sum, the Government land grant.

But let me refer again to the population of French Canada. Remember that it is steadily increasing, and that it is far from having reached the high-water mark. Not very long ago the Right Hon. Leonard Courtney made some remarks before the Society of Arts which are well worth reproducing. He said:—

"The French race in Canada was not a dying race. Under the Constitution of the Dominion of Canada the representation of the province of Quebec in the House of Representatives was fixed for a certain number of members. The representation of the other provinces varied, bearing the same proportion to the representatives of the province of Quebec that the population of the other provinces bore to the population of Quebec. When the Dominion Act was passed it was snpposed that the representation of Quebec being absolutely fixed, and the other provinces getting more and more thickly populated, the other provinces would, every ten years when there was a revision, receive an addition to the number of their representatives, their number growing, whilst those of the province of Quebec would remain stationary. But the last census of Canada brought out the most unexpected fact that the French had increased in population more than the rest of Canada, so that instead of increasing the representation of other provinces in the Dominion in the House o Representatives, the provinces had to undergo a diminution of numbers in order to bring down their number to their proper ratio."

I must now revert to history, and that in a very brief way, in order to explain the present position of the French Canadian as regards his language, his religion, his laws, and what I shall call his political affinities, in the broadest sense of the word. I have already described the adventures of the French pioneers on the continent, and I have pointed out that the mainstay of French Canada was not the fur trader, or the soldier. The peasant, the farmer, the *habitant*, was above all others, the maker of French Canada.

It would be quite unnecessary for me to relate here the history of the long struggles between France and England for the supremacy in North America. In September, 1759, the fall of Quebec virtually decided the issue between the two nations. In 1760, Montreal surrendered, and in 1763, by the Treaty of Paris, Canada became a British possession. There is nothing of more thrilling interest than the narrative of the battle of the Plains of Abraham, where the generals of both armies died for the cause of their respective countries. Parkman has graphically described the siege of Quebec, but there is one page which is perhaps more fascinating than all others. It is where he describes the bold and successful attempt of Wolfe and his army to reach, in the dead of night, the plateau above, known as the Plains of Abraham.

Let me quote a few lines:—

"The heights near by were cleft by a great ravine, choked with forest trees; and in its depths ran a little brook, called Ruisseau St. Denis, which, swollen by the late rains fell, flashing in the stillness, over a rock. Other than this, no sound could reach the strained ear of Wolfe, but the gurgle of the tide, and the cautious climbing of his advance parties as they mounted the steeps at some little distance from where he sat listening. At length, from the top came a sound of musket shots, followed by loud huzzas, and he knew that his men were masters of the position. The word was given, the troops leaped from the boats and scaled the heights; some here, some there, clutching at trees and bushes, their muskets slung at their backs. Tradition still points out the place, near the mouth of the ravine, where the foremost reached the top. The narrow slanting path on the face of the heights had been made impassable by trenches and *abattis*; but all obstructions were soon cleared away, and the ascent was easy. In the grey of the morning the long file of red-coated soldiers moved quickly upward and formed in order on the plateau above."

It was on that eventful day that French Canada became British. Being fatally wounded, General Montcalm sent the following note to Brigadier Townshend:—

"Monsieur,—The humanity of the English sets my mind at peace concerning the fate of the French prisoners and the Canadians. Feel towards them as

they have caused me to feel. Do not let them perceive that they have changed masters. Be their protector as I have been their father."

If not all the early Governors treated the new subjects of George III. in the spirit of Montcalm's last letter, it is only fair to state that at least two of them, Governor Murray and Sir Guy Carleton understood the peculiar circumstances in which the French Canadians found themselves, and by their liberality and true statesmanship ultimately saved Canada from American invasion. The incessant warfare between the English and the French in America had left the Canadians in a state of misery and hardship. Unlike the regular who came with the fresh regiments from France, and who had none but a military career in mind, the Canadian was, or rather had to be, both a farmer and a soldier. Always on the *qui vive*, being constantly bled white for the maintenance of the troops, being inceasingly dragged from his farm and rushed to the frontier, he—after the fortunes of war had decided against his King, made two portions of his heart—one to the old Motherland which, in the language of Sir Wilfrid Laurier, gave him life, and the other, to the great nation which ultimately gave him liberty. By what process did he obtain his liberty from the conquering nation? Here, again, it would be trespassing on your time if I were to go into every detail of our political struggles. The period extends from 1774 to 1841. Let me refer to it very briefly.

From 1760, the year of the capitulation of Montreal, until 1774, the Government of Canada was of a rather unsettled nature. It was partly military and partly civil. The British authorities found in their new subjects a disposition to abide by the fortunes of war, and to shape and mould their destinies according to the new regime. As I said a moment ago, the French domination had left the habitant in a helpless condition, financially speaking. After the capitulation of Montreal, the nobility, the officers, mostly all the regulars, and many of the wealthy merchants, returned to France. He was practically left to himself. The clergy alone remained. From that day the *curé* became not only his spiritual adviser but his political guide as well. There is, and there will always be in French Canada, a traditional love and respect for the priest. Jean Baptiste will never forget that in the darkest period of the history of his race, the *black robe*—as the Indians called the missionary — remained faithful to him. And the early Governors, with a foresight that does them credit, wisely understood how useful would be his influence.

The English-speaking population, chiefly centred in Montreal and Quebec, was then very limited in numbers. It is estimated, on the contrary, that the French numbered about 60,000, which constituted the overwhelming majority. Three great issues faced British diplomacy—the religion, the laws, and the language of its new subjects. Would the Ministers of George III. attempt to eradicate from Canada the religion, the laws, and the language of their defeated foe? Strange to say, there were some who not only believed in this somewhat radical process, but who firmly advocated it. The Ministers, however, of George III., thought otherwise, and in spite of passionate appeals to the contrary, they obeyed those sentiments of humanity and justice, which from time immemorial have permeated the whole fabric of the British colonial policy. In 1774, here, at Westminster, was passed the famous Quebec Act, which we, French Canadians, consider as our Magna Charta—as our Bill of Rights. Briefly analysed, this Act officially recognised the rights of the Roman Catholics in Canada—and that at a time when in other colonies and plantations, even in Great Britain itself, Catholic disabilities existed; it maintained the civil laws which had hitherto governed the colony. It extended to the colony, in the same enactment, the benefit of the writ of *habeas corpus* of the English criminal and commercial laws. It created a Legislative Council, and provided for the future establishment of a popular House of Representatives.

This legislation, unparalleled in the history of foreign Colonial government, made of every right-thinking French Canadian a true and loyal British subject.

The American Revolutionary war broke out. France became the ally of the Thirteen Colonies. She sent money, she levied troops, she commissioned ships in aid of the Rebellion. Lafayette appealed to the racial passions of the French Canadians, and urged them to join the rebels. Carroll, a young ecclesiastic, who, later on, became Bishop of Baltimore, appealed to their religious feelings.

The French Canadian's unflinching loyalty asserted itself for the first time. One can see in Montreal the stone gate with the old French sun-dial, under which Carroll stood when he parted from the venerable Superior of St. Sulpice, whom he had vainly urged to preach rebellion to his flock.

In 1791, a new Constitutional Act was passed by the Parliament of Great Britain, the chief object of which was the creation of a popular Assembly. Imperfect as it was, the new Constitution had the effect of bringing the French Canadians into contact with the British Parliamentary institutions. Even at that early stage of Parliamentary government, the elected representatives of French Canada soon became conversant with all the principles which form the basis of the British Constitution. Nowhere in the Colonies was the Parliamentary system more appreciated; none of His Majesty's subjects adapted themselves more quickly to it. They had not been accustomed under the old régime—a régime essentially bureaucratic, where the Government was concentrated in the hands of a few belonging to the privileged class—to the freedom which, after all, is the corner-stone of the British constitutional fabric.

In 1812, the Americans again invaded Canada. The French Canadians again gave evidence of their gratitude towards Great Britain by repelling the invaders.

I have said that the new Constitution was imperfect, although it purported to create a popular House. After the American invasion, an evolution essentially political in character took place in Canada. A popular House was a sham, if above it, was an executive power controlling the expenditure and the right of appointment to judicial and administrative positions. Yet, such were some of the powers which remained vested in the Governor, who had no advisers responsible to the House.

This, and the spirit of reform which agitated England herself in those days, caused the Constitutional storm in Upper Canada, in Lower Canada, and in Nova Scotia.

It culminated in an open rebellion both in Upper Canada and in Lower Canada. In French Canada, Louis Joseph Papineau was the leader of the Constitutional agitation. His lieutenants, who went further than he ever wished to go, were Wolfred Nelson, Robert Nelson, and Thos. Storrow Brown—English names. In Upper Canada, the rebellion was led by Wm. Lyon Mackenzie, Lount, and others. In Nova Scotia, the leader of the Constitutional agitation was Joseph Howe.

Speaking for the French Canadian rebels, I may say that none of them ever fought the flag of England; they fought the family compact, a bureaucracy, a power-holding class. The same may be said of the Upper Canada rebels and Nova Scotia agitators. It is historically true to say that Mr. Papineau himself was strongly in favour of British rule. Speaking to his electors of Montreal West in 1820, and contrasting the condition of the country under the British rule, with the sad picture of the colony under the French *régime*, he used the following language:—

"Behold the change! George III., a sovereign revered for his moral character, attentive to his kingly duties, and love of his subjects, succeeds to Louis XV., a prince then deservedly despised for his debauchery, his inattention to the wants of his people, and his lavish profusion of public moneys upon his favourites and mistresses. From that day the reign of law succeeded to that of violence, from that day the treasures, the navy, and the armies of Great Britain are mustered to afford us an invincible protection against external dangers; from that day the better part of her laws became ours, while our religion, property, and the laws by which they were governed remained unaltered."

Enough on this subject. The fact remains that the rebellion was the turning point in our Constitutional history. Lord Durham was sent to Canada, and in his celebrated report he laid down a policy which, wisely adopted by Great Britain, has made the tie which binds the Colonies to the mother country unbreakable. And never before was the strength of the British Empire better illustrated than during the latter portion of our late beloved Queen's reign. If the Royal pageants of 1897 and of the Jubilee were surpassed by the Field of the Cloth of Gold, they, however, will remain unique in history for their vast political significance. There it was seen that, unlike the Emperors of old, who drew to their chariots barbarian hordes, Queen Victoria kept in the bonds of love peoples, nations, languages of heterogeneous nature. Her moving spirit has been liberty, not despotism: her glory the glory of peace, not of war; her triumph was not in obedience to a command behind which was the force of victorious legions, but the nobler expression of true loyalty.

Now, what language does a French Canadian speak? The French Canadian speaks not a *patois*, as has been suggested to me on different occasions. Far from it; he speaks the language which is usually heard in Western and Northern France. Many archaisms can be detected in his conversation, but that is quite natural if one considers his origin, and, besides, it is picturesque, and lends colour to his language. Many Anglicisms have also slipped into the common phraseology, but the educated class will always avoid them. This,

again, is easily explained by the fact that in a country where two languages are spoken, where the relations between the two races is so intermingled, there must be some confusion in the choice of words. In Canada, the English language being the language of commerce and industry, it follows that the French Canadians are somewhat tainted with Anglicisms. I might mention, however, that an effort is being made at present to check this rather adulterating influence. A society of French Canadian *littérateurs* has been organised in Quebec; it is called "La Société du parler français," and it issues a monthly bulletin, in which the Anglicisms are pointed out with the corresponding corrections. This only shows what paternal care is taken amongst the educated classes to preserve in its purity the mother language. I may add that our English-speaking friends, far from being offended by this movement, view it with favour. They understand, as we do, that since two languages are inevitable, they both must be carefully protected. I am glad to say that for a few years past, the French language has been taught in the higher institutions of English Canada. McGill University, Toronto University, Queen's University, in Kingston, all have their French class as part of the curriculum. They have their French professors, and at McGill University, for instance, a series of lectures is being given annually under the patronage of *L'Alliance Française*. English-speaking Canadians fully appreciate the value of a literature which has produced a Corneille, a Racine, a Molière, and, in more modern times, such masters as Hugo, Lamartine, Musset, and others. Of course, the French Canadians who speak English far outnumber their fellow-countrymen who speak French. A business man of French origin, as a rule, speaks and writes quite fluently in both languages. French Canadians in the professional classes, barristers, doctors, professors, journalists, clergymen, civil engineers, are still more familiar with both languages.

The farmer—or as he is generally called the *habitant*—speaks only French, with the exception of those rural districts such as the eastern townships, where he is closely in touch with the English-speaking settler.

It has often been hinted that the French Canadians might in the course of time be absorbed by the growing tide of the English immigration. This surely cannot apply to Quebec as I will point out in a few moments. It did not apply in Ontario nor in the maritime provinces, where the French element is far from being as compact as it is in Quebec. It may occur, it has, in fact, occurred in some parts of the United States with the younger generation, and that, because in some instances, the French Canadians did not enjoy the privilege of being taught in schools of their own. But as regards Quebec, the dominant language will always be French. My countrymen are deeply attached, not only to their faith, but to their language. It has been their duty to cling with perseverance to their national traditions; it has been the honour of the British Crown to respect that sentiment. After all, would they not be unworthy of themselves, unworthy of the great race from which they sprang if they had forfeited such a sacred inheritance? What better illustration can there be of the great freedom enjoyed under the British flag than the respect and the protection afforded to a minority such as the one to which I belong? The foreigner who happens to witness a Parliamentary debate in the House of Commons at Ottawa cannot but be deeply impressed with the immense benefit derived by minorities under the British Crown. There, he will hear the Speaker reciting the prayer one day in English and the following day in French. There he may listen to a debate where the representatives of both races will express their views in either language. There, also, he may read Hansard in French or in English. If he consults the Blue-books, the statutes, in fact, any official document, he will find the same duality of language.

What has been guaranteed by the Constitution to the French minority in the Federal Parliament, has also been stipulated in favour of the English minority in the Quebec Legislature. In the House of Commons, there are about 60 French Canadian members out of 214 representatives. In the Quebec Legislature, there are about 12 English-speaking members out of a deputation of 73.

Not many months ago, the Speaker of the Assembly was selected amongst those who belonged to the minority.

In the House of Commons, it has been the invariable custom since confederation to alternate at each Parliament in the choice of the Speaker. The same unwritten law prevails in the Upper Chamber.

This reminds me of a parliamentary scene that I witnessed during the session of 1903. The session was rather long and memorable as a result of the passing of a Bill providing for

the construction of a new trans-continental railway. The debate had been somewhat protracted and several other Bills had to be sanctioned before the prorogation. His Excellency the Governor-General was absent from Ottawa, but the law provides that in his absence, his duties can be performed by the Chief Justice of Canada. On that occasion the Acting Governor-General was Sir Elzear Taschereau, Chief Justice of the Supreme Court. By his side stood Sir Wilfrid Laurier, Prime Minister of Canada. At the bar of the Upper Chamber, preceded by the Macebearer, stood the Hon. Louis Philippe Brodeur, Speaker of the House of Commons. The Clerk of the Senate was Major Samuel Chapleau, who, as is the custom, holding in his right hand the Bills assented to, recited the old Norman formula, which has been preserved here at Westminster, with so many other old Norman usages: "Le roy remercie ses sujets, accepte leur benevolence, et assente à ce Bill."

I freely confess, as a French Canadian, that my heart swelled with emotion, that my eyes were dimmed with moisture at such a spectacle. There, in a British colony, the men who belonged to the minority stood at the helm of the State. In no other country in the world, and probably under the British Crown alone, can such a spectacle be witnessed.

Our civil laws are unquestionably of old lineage, but they are by no means antiquated. They are, in spite of their venerable age, perfectly adaptable to modern requirements. They are the product of a civilisation which our so-called up-to-date refinement can well envy. The underlying principles of the *Coutume de Paris*, and the *Ordonnances* of Louis XIV. and Louis XV., can be traced back to that pure fountain from which flowed all jurisprudence, ancient and modern. I refer to the Roman law.

The Judicial Committee of the Privy Council has often expressed its admiration for the equitable and fair provisions of our Civil Code, for its clearness and its concision.

That the French Canadians were entitled to retain their civil laws, no less an authority than Lord Mansfield himself freely admitted.

Some people say that there should be uniformity of laws and language in the Dominion, that it would be far more practical. Those who look at such a question, from the only practical point of view, are apt to forget that sentiment is no mean factor in the map of life. Nor do I question the motives of those who preach uniformity and fusion as regards the various elements in Canada, but it seems to me that the other point of view should not be disregarded. Uniformity may be desirable in some cases; in others, variety may be most appropriate.

A well-known writer published a book some years ago with this suggestive title, "Put Yourself in his Place." I would ask those who clamour for uniformity to put themselves in our place. Our traditions, our laws, our language constitute, as I have already said, the inheritance which was left to us by our forefathers in 1759. It is a glorious heritage which a true French Canadian will always treasure. Would not his English-speaking friends have less respect for him if he had been unfaithful to his sacred trust? For an Englishman valour is still of value; he will always admire courage, thrift, perseverance displayed in adversity by his defeated foe.

I said a moment ago that variety was, in some cases, more appropriate than uniformity —*l'ennui naquit un jour de l'uniformité.* Variety is an element of beauty not only in nature but in nations as well.

Let me remind you of what happens every day, here, in London, at the very heart of the Empire. In Downing-street, next to the residence of the First Lord of the Treasury, sits the Judicial Committee of the Privy Council. This able body of men, some of whom may be classed amongst the greatest jurists in the world, hold periodical sessions in order to hear the appeals from the several colonies of the British Empire. From the Cause List, you will notice that one day an Indian case may be heard and the next day a Canadian one. One day the appeal is from Bengal, the next day it is from Mauritius or Ceylon. Each of those colonies—not to mention the many others—have kept their own laws, and one who is a daily attendant of the sessions of the Committee, can listen to very able arguments indeed, based on either the Common-law, the Roman law, the Dutch law, the Indian law, the *Coutume de Paris*, or even the *Coutume de Normandie*.

A few days ago, at the opening of the term, holding myself a brief from the Dominion Government, I was awaiting my turn to make an application. A case was being argued by two of the most distinguished counsel of the British bar—I refer to Sir Edward Clarke, K.C., and the Right Hon. R. B. Haldane, K.C. Passing from the robing-room to the Court, I was struck by the number of large old books piled up on the table near the bar. It seemed

to me that they bore some resemblance to our old law books in Quebec, such as the "Coutume de Paris," "l'Ordonnance de 1667," and their commentaries. Suddenly I noticed, sitting near by, my esteemed *confrère*, Mr. Durell, K.C., Solicitor-General of Jersey, whom I had the pleasure to meet last year at St. Heliers. He at once explained to me that a Jersey case was being argued, and of course the dusty old books spread on the table were near relations to our old Quebec books. Here was the old "Coutume de Normandie," and there the "Stile de Procedure du Parlement de Rouen." In Quebec the corresponding books would have been the "Coutume de Paris," which still governs us though codified, and the "Procedure du Chatelet de Paris," which contained the Ordonnance of 1667, also codified. Needless for me to say that I followed with deep attention and great interest the argument on both sides. The names of the litigants were all French. Some of them were present in court and looked so much like our own folks in Quebec. I may say, *en passant*, that the *habitant* in Quebec has lost none of the characteristics of his Norman ancestors. Above all, he is fond of litigation, and the number of barristers in Quebec is increasing year by year.

The laws cited were French. In fact, the whole atmosphere of the Privy Council was permeated with French on that day. Looking at all those counsel wigged and gowned as the *conseillers* and *avoués* of old, listening to arguments based exclusively on the antique custom of Normandy, one might have easily dreamt that he had witnessed the famous assize of the Parliament of Rouen three hundred years ago. May I add, *entre parenthèse*, that in Jersey as in Quebec both the English and French languages are official. In the States, "Les Etats de Jersey," English is mostly spoken, but any attempt to abolish the French language would be deeply resented. The laws are French as I have just pointed out. The division of the island in twelve parishes is not unlike our parochial system in Quebec.

Their seigneurial tenure differs in some respects from the seigneurial tenure which existed in French Canada until 1854, but some of the *droits seigneuriaux* bear a striking resemblance to our own.

The Jerseyman, as the French Canadian, is a pure Norman type. At St. Heliers, as in Montreal and Quebec, he speaks French and English indifferently. In the parishes, the Jersey farmer, just as the Quebec *habitant*, speaks mostly French as a rule. There is some *patois* in Jersey; there is none in Quebec. We find, however, the same archaisms in the language spoken by both the farmers of Jersey and Quebec.

I have laid some special stress in speaking of Jersey, because, from an Imperial point of view, the Channel Islands are much like Quebec, except as regards religion. Here, they are Huguenots—there, they are devout Catholics; but both cling to their national traditions, to their language, to their laws, to their customs, to their usages, and, at the same time, both are extremely loyal to the British Crown. Both have given evidence of their loyalty—their sons have fought and died for the British flag. Both are, however, of a conservative frame of mind. A change in the Constitution, an alteration in the laws, is always looked upon with apprehension. A man who, after long struggles, has at last succeeded in obtaining what the Latin poet has so aptly defined as *aurea mediocritas*, will not be easily induced to barter the fruit of his travail and efforts. A man who is satisfied with his lot, unless he is very impulsive, will pause and reflect before saying "Yea" to any new proposition presented to him. Nations are not unlike individuals in this respect

The French Canadian, having received under the flag of Great Britain the rights, liberties and franchises, the enjoyment of which is the birthright of every British subject, he cannot expect—and, in fact does not look for—a better *status*. Any annexation movement would find in him an uncompromising opponent. He knows fully well how soon his nationality would be merged in the American Union.

The British North America Act has given the several provinces the control of their local affairs – civil, religious, educational, municipal. In Quebec, as well as in the other provinces, the majority rules; but our English Protestant fellow-citizens, who there are in a minority, have always received a most generous treatment at the hands of the majority. Having obtained the right to govern himself, the French Canadian takes a great interest in political affairs, especially in those which concern his province. He knows the value of responsible government. He loves the land of his ancestors. It is not an adopted country for him; it is his country. Occasionally, he will emigrate to the New England States in order to pay off a mort-

gage, but he never bids a final adieu to his province. His heart remains behind among the long pastures, the bright-hued villages, the tall-spired churches of old Quebec.

There are some Imperial problems looming up in the political horizon to the ultimate solution of which the French Canadians are by no means indifferent. What may appeal strongly to their fellow citizens of English origin on account of the ties of blood with the Mother Country, may not appeal so strongly to my fellow countrymen. The reason is quite obvious. The French Canadian belongs—and that for many centuries and generations — to Canada. He has no connection, except intellectually speaking, and that in a qualified way, with France. His estrangement from France is manifold. First, he was ceded in 1763 by the treaty of Paris. Then, even before the cession, there was a marked difference between the Canadians, that is to say, the permanent settlers, and the military class, soldiers and officers included. The correspondence between Montcalm and Vaudreuil and the archives of the *Ministère de la Marine* in France are conclusive evidence of my statement. Then again the French Revolution, which destroyed monarchy, re-organised the Church, centralised the Government, and codified the laws and customs, created an abyss between the Canadians and modern France. For more than half a century after 1789,there were no relations between the old colony and the old Mother Country. Indeed, it was not until the Crimean War that the French Canadians took some interest in the affairs of France. The alliance of England and France on the battlefields of the Crimea aroused the enthusiasm of the people, just as the present *entente cordiale*. For the first time since 1760 a French warship, *La Capricieuse*, anchored in the waters of the St. Lawrence. For the first time also the French tricolour was displayed—but, mark well, the tricolour, hitherto unknown in Quebec, was imported by the English-speaking merchants, who distributed it amongst their customers to decorate their houses after Balaklava, Alma, Sebastopol. The French Canadian has worked out alone his destinies in the New World; he has won his civil and religious liberty under the *régime* which followed the cession. All his traditions are, therefore, Canadian. On the contrary, British settlement in Canada is of a more recent period, and especially during the last half-century an unceasing tide of emigration has poured in from the United Kingdom. Nearly every English-speaking Canadian has many relations on this side of the water, and when he crosses the ocean he is coming home, as he says. Hence blood, which is thicker than water, will quite naturally stir his feelings in all matters—be they political, social, or intellectual—which affect Great Britain and Greater Britain. The loyalty and fealty of a French Canadian towards the Crown is none the less actual and sincere because he does not respond with the same fervour as his fellow-citizen of English origin to an Imperial federation scheme, for instance. He has not been trained to be especially concerned in the affairs relating to India, New Zealand, Australia. No traditions of his, no associations of his, lead him to look instinctively at those distant parts of the Empire as being political partners. Is it, pray, surprising that he should not evince the same intense interest which you in Great Britain, which not a few in Canada, take in the great Imperial issue? After all, the views of the French Canadians, as a whole, on this question are those expressed by the Colonial Premiers at the Conference of 1897. In reply to the proposal made of creating a Great Council of the Empire, they passed the following resolution :—

"The Prime Ministers here assembled are of the opinion that the present political relations between the United Kingdom and the self-governing Colonies are generally satisfactory under the existing condition of things."

At the next Imperial Comference of 1902, the question of contribution by Canada to the Navy and the Army, was thus summarised :—

"That the taxpayers of the United Kingdom should desire to be relieved of some of the burdens which they bear in connection with military expenditure is quite reasonable. Canada, in the development of its own militia, will be found ready to respond to that desire by taking upon itself some of the services in the Dominion which have hitherto been borne by the Imperial Government. What has already been done by Canada must give assurance of the disposition of the Canadian people to recognise their proper obligations.

"At present Canadian expenditures are confined to the military side. The Canadian Government are prepared to consider the naval side of defence as well. On the sea-coasts of Canada there is a large number of men admirably qualified to form a naval reserve, and it is hoped that, at an early day, a system may be devised which will lead to the training of these men, and to the making of their services available in time of need."

In accordance with the views expressed at the last conference, Canada has nearly doubled her military expenditure, has assumed control of Halifax and Exquimalt, and the question of the creation of a Canadian naval reserve is now on the tapis. Not a dissenting voice was raised in Parliament against this new departure.

As regards cheap postage, preferential tariff, Trans-Pacific cable, to mention only a few of the questions of Imperial concern, Canada, as a whole, did her duty.

As a matter of history, the French Canadians may justly claim to have done their share towards the development of the Dominion as part of the Empire. The "Grand Old Man" who has done me the honour of presiding at this lecture, knows fully well that without the assistance of Sir George Cartier, Sir J. A. Macdonald could not have united into a confederacy, the then scattered and isolated British provinces of North America.

The two Bills relating to the construction—first of the Canadian Pacific Railway, and second, of the Grand Trunk Pacific Railway, have been introduced in Parliament, in one case by Sir George Etienne Cartier, and in the other by Sir Wilfrid Laurier. The Canadian people, irrespective of races, look upon those two gigantic enterprises not only as mere commercial highways, but as military routes to be of service to the Empire at large in case of need.

Let me say, in conclusion, that the *entente cordiale* was a God-send to Canada. The two races lived in harmony, side by side—but there were at times outbreaks of the old feuds. If that *entente cordiale* was necessary here in Europe, it was specially beneficial to us Canadians, who have a common destiny, though not a common language.

For my part, I am convinced that it will have a lasting influence upon the future of Canada. It will draw closer together the two larger elements of the Commonwealth; it will bind into one sheaf the aspirations of the two races; it will be for both of them a lesson of tolerance and mutual respect; it will obliterate prejudices, and will bring into bold relief virtues and qualities hitherto unknown; it will cast into oblivion racial passions, and bring instead amity, confidence, and harmony. It will give our young country a new impetus towards progress under the ægis of the British flag.

DISCUSSION.

The CHAIRMAN said he was sure that they had all listened with the greatest interest to the admirable paper that had been read by Mr. Lemieux. He did not believe that they would find any history of Canada condensed into small space so truthful, so really correct as that they had listened to with interest and instruction. It was a great pleasure to have heard such a paper read by one who knew the country so thoroughly and who was so completely unbiassed. Mr. Lemieux had spoken of the English and the French with perfect sincerity and not with a view of pleasing one party or the other. His object was to give a true account of the matters dealt with, and in this all would agree that Mr. Lemieux had been eminently successful. To what he had told them of what had been done by the French-Canadians he (the Chairman) might add a little, and a very little. It was the French-Canadians connected with the North-West Fur Trading Company who formed the first canal joining the waterway courses of Canada. Somewhat more than 100 years ago they constructed a canal through Sault Ste. Marie, before there was any thought of making it a portion of the United States or of Canada. That said something for their enterprise. It was not too much to say that had it not been for the assistance received from the French-Canadian, it would have been impossible for the North-West Fur Trading Company and the Hudson's Bay Company to have accomplished what they did. He would wish to point out with what toleration the French-Canadians, and the Church to which they belonged, regarded their Protestant brethren. In Montreal, many years ago, the Catholics gave up their Church for one-half of the day to the Protestants who had not a place of meeting of their own. Mr. Lemieux had told them that there was room in Canada for 100,000,000 people. He (the Chairman) believed that by the close of the present century there would be a prosperous population, numbering at least 80,000,000. It was impossible that it could be otherwise if they looked to what had taken place within the century in the United States. Canada had in some respects greater advantanges than the United States, where in the extreme south it was not what could be called a white man's country, and labour must be performed by the negro. Canada, from the boundary line to the north, was, every inch of it, truly a white man's country, in which he could enjoy life and thrive.

THE DUKE OF ARGYLL, K.T., G.C.M.G., said their Chairman was in all respects a typical Canadian, representing in his own person a country which had never touched anything in which it had not succeeded. That was a characteristic of Lord Strathcona and of the Canadian people. He thanked Mr. Lemieux for his most excellent paper. It was not an easy matter to roam over so great a space of history and yet to make every sentence pointed

lively, and interesting, and to hold the attention of the audience throughout. Mr. Lemieux had described the career of the all-conquering Norman. In his words they said: Let bygones be bygones. So much was that the case that he remembered hearing the other day, that when someone was pointing out the Field of Hastings, the place where Harold was killed by the Normans, a countryman, passing by, who did not quite hear all that was said—he caught part of the words about Harold being killed—remarked, "Oh, yes, and they do kill ducks here sometimes." That countryman had at all events entirely forgiven the Normans. The Normans did to us very much what the French-Canadians did. They were in the habit of taking up all the best things they could get. They discovered lakes, forests, and hills, and got water and other power, and had the best of the country allocated to themselves. Mr. Lemieux had mentioned that their loyalty was now perfect. Well, it always was so; and he thought the feeling with regard to the French at present in Europe was one of kinship and love; but that the flag they reverenced was the old white flag of France rather than the tricolour, politically at all events, of the present day. But Mr. Lemieux had gone on to speak of the abiding influence which the French race would always have in Canada. He (the speaker) hoped they would always have that influence, which was one for refinement, for good, for religion, and for straightness and honesty of purpose. He was rejoiced to hear what Mr. Lemieux had said with regard to his concurrence—and they must not touch much upon politics—in those measures which tend to make us more and more one nation in warlike equipment—not for offence, but for defence. He believed his policy was at present to encourage a marine militia in Canada; it would meet with the approbation of the French as well as the English Canadians in the maritime provinces. He thanked Mr. Lemieux for what had been said with regard to present subjects, as well as for the most illuminating and charming address he had given upon the past history of his people.

Mr. J. Allen Baker, M.P., said that after the graceful speech that had fallen from the Duke of Argyll it needed no word of his to express the warm appreciation that everyone had felt for the excellent paper that had been read by his fellow-countryman. He could only say as a native of Ontario that the relations between the provinces were of the most cordial character. All that Mr. Lemieux had said as to the loyalty of the French-Canadian and the loyalty of the Canadians as a whole was absolutely true. If any further proof of that was required he thought one only needed to pay a visit to the Dominion and go from Atlantic to Pacific to find how thoroughly loyal every Canadian is to the old land, and how perfect the understanding they have with provincial Parliaments and the federated Parliament at Ottawa in controlling the destinies of that great country. He had an opportunity during last summer of traversing the great North-West in company with the Right Hon. John Burns, and they were immensely struck with the possibilities, resources, and rapid improvement and colonisation that is taking place throughout the great North-West. He was fully convinced that the prairie country of the North-West is much superior to the great proportion of that which lies south in the United States, and he could fully confirm the statement that those who were going into Canada are so absolutely satisfied with the freedom and security that they find there that in almost every case they are ready to naturalise and become true Canadians, and to find their security and prosperity under the Union Jack. Mr. Burns and he were very greatly struck with that fact. They could not go through Canada to-day without seeing substantial signs of prosperity. There was a spirit of hopefulness and enthusiasm in regard to the possibilities of Canada in the future—no evidence of poverty to be seen from one side of the country to the other. Railway construction was rapidly developing. The Great Canadian Pacific, with its 11,000 miles of track, was, of course, being taxed to its very utmost to bring the 100,000,000 bushels of grain that had been produced in the North-West for the year to the markets. And when the Grand Trunk Pacific was carried through, the third of the great trans-continental lines through British territory, they would have developments which he thought would astonish those who had not had the opportunity of actually seeing on the spot the progress that is being made. He should like to say with what veneration Canadians looked to the great work and to the noble part that had been played in Canadian history by their noble chairman. As one of the pioneers of the development in the North-West his name would ever be remembered. The Canadian Pacific Railway had been likened to the Dominion on wheels. His companion on the journey he had referred to, who was always versatile, said, after going over that great system, "If it had been called in the past the Dominion on wheels," it might in the future be called the Dominion on roller bearings. It was working with so much smoothness, and having so great an influence in the developing of the country, that that simile was one that could well be used. He thought they would all remember Mr. Lemieux's paper, not only with interest, but with profit.

Sir Hugh Gilzean-Reid said he was sure they had all been delighted and inspired by the historic, exhaustive, and graphic paper read by Mr. Lemieux. Last year it had been his privilege to visit Canada. It was hardly possible to realise, unless one was there, that there were far over a million Frenchmen and Frenchwomen in Canada, French in descent, in language, in spirit, and characteristically French in a moral and physical sense,

and yet forming part of a compact, contented, prosperous, and loyal community—part of the British Empire. What a lesson to them all in the old country! What had produced these beautiful and marvellous results? It was that all down the years they had treated Canada in a spirit of justice, trustfulness and liberality, which had produced the natural outcome—contentment, devotion and loyalty. Why should they not be able to do the same with an apparently less alien race in South Africa, and with how much a less alien race in Ireland? The lesson they had learned that afternoon would go deep into their hearts, and strike into the hearts of others. The summaries in the newspapers, and the full report in the *Journal* of their Society, would go to form part of the history of that great country, spreading true light, inspiring a new and better spirit. They would agree that they were equally indebted to Mr. Lemieux and to the Society for bringing them together, to hear something of their brethren over the water, to shake hands as it were with them, and pledge themselves to eternal and ever-brightening friendship.

Mr. Donald MacMaster, K.C., entirely shared in the expression of opinion so complimentary to the excellent paper that his friend Mr. Lemieux had read. Mr. Lemieux spoke in the English language, and was very modest about it, but it was not necessary that he should be so absolutely modest, because great as his command of English was, it was nothing to the command he had of the noble language of France. If they only heard him addressing a jury, or a French audience in French-Canada, they would really say that Daniel O'Connell, if he came back, would have to look to his laurels. Now he was not going to refer to anything of a controversial character. It was not wise that, where everything was so absolutely in agreement, in admiration of Mr. Lemieux's scholarship, and the admirable manner in which he had treated his subject, anything should be suggested which was controversial. As was said by a distinguished statesman in this country, "Up to a certain point we can unite; it is not necessary that there should be a division." It was perfectly true, with respect to the two great transcontinental roads, that the Bills were introduced by French-Canadians. But the Bill that actually prevailed, and upon which the Act was passed that warranted the construction of the Canadian Pacific Railway, was introduced by his friend Sir Charles Tupper. He did not say that in diminution of the fact Mr. Lemieux had stated, because what he stated was absolutely correct. It was only an omission, and he was supplying it. He (Mr. MacMaster) thought that a better-natured or more good-neighbourly people than French-Canadians it was impossible to meet. But besides that, they produced a great number of very able and eminent men, able in discussion, in science, in literature. At the bar they were most formidable competitors. In Parliament they were their greatest orators; and if one only looked to the great matter of office-holding, they proportionately held far more offices than any other nationality. His friend said that the French-Canadians were well satisfied and loyal, and he had no doubt they were. There had been acute differences, perhaps, and sometimes the English people thought that they did not go far enough at a time when they should go forward; but then, on the other hand, it must be remembered that in the only two wars they had, in defence of their frontier, Frenchmen were found fighting in the foreground. In other respects, of course, there was every reason that they should be happy. They lived in a free country, and enjoyed British institutions, and after all, British institutions were no small asset. This had a good deal to do with the happiness of the people. They must think when and where they applied them, and be sure that they applied them at the right time. But the French-Canadians enjoyed them, and did know how to appreciate them. They got the fruits and protection of them, and they got the offices. If the great Montcalm could return to Canada to-day and take a survey of it what would he behold? A happy and united population in French-Canada, enjoying true British institutions. If he looked at the old city of Quebec, where Montcalm fell, he would see a Frenchman Governor to-day, the father-in-law of the reader of the paper, and another French-Canadian Chief Justice of the Superior Court. If he went to Ottawa he would see the first commoner, the Speaker of the House of Commons, a French-Canadian. If he went to far British Columbia he would see Sir Henri Gustave Joly de Lotbinière, a French-Canadian, in office. If he went to the North-West territories he would see Mr. Amédée Emmanuel Forget, Lieutenant-Governor and formerly the Governor of the whole of the North-West territories before it was divided into the new provinces of Alberta and Saskatchewan. If he went to the Province of Quebec he would see the Chief Justice, the Hon. Sir Alexandre Lacoste. Again, if he went to the City of Ottawa, what would he behold? The reader of the paper as the Solicitor-General, the Right Hon. Sir Elzear Taschereau, Chief Justice of Canada, and the first Minister of the greatest colony of the British Empire a French-Canadian. And all from the fragment of 70,000 people left in French-Canada. Verily, this should be a happy and contented people! If Montcalm in his latest moments could have foreseen all this he might have expressed his thoughts in the dying words of Wolfe, "Thank God, I die happy!"

The Chairman said they had had a most pleasant evening. It remained for him only to ask them to express in the warmest possible way their sense of gratitude to Mr. Lemieux for his admirable

paper. He had very great pleasure in returning to him their grateful thanks.

The resolution was carried unanimously.

The Hon. RODOLPHE LEMIEUX, in responding, thanked them for their kindness, and appreciation of his paper. Addressing the Chairman, he said, his Lordship was kind enough to say that they were living in Canada in perfect harmony—the French and the English, the Protestants and Roman Catholics, and he had referred to that famous instance when the Récollet Church was lent by the Roman Catholic clergy to the Protestant clergy of Montreal. That was one part of the story. But might he mention to that very important and representative gathering a fact, which he thought was unknown, and one must not be surprised that it was unknown, well knowing the modesty of the generous man who performed the act. Two years ago was the fiftieth anniversary of the foundation of their great Roman Catholic and French Canadian University in Quebec, Laval University. From all parts of Canada came very liberal subscriptions for the foundation of new chairs, and for the embellishment of the University. But he was proud to say before that audience in London, at the very heart of the Empire on behalf of the French-Canadians and the Professors of Laval University (because he happened to be one of them) that the most liberal subscription came from Lord Strathcona—a good Scotch Protestant, but always generous and kind-hearted for his fellow-countrymen, to whatever religion they belonged. He (Mr. Lemieux) accepted with pleasure the addition by his friend Mr. MacMaster.

Sir FREDERICK YOUNG, K.C.M.G., on behalf of the committee of the Colonial Section, said they were much indebted to Lord Strathcona for his presence in the chair. Lord Strathcona's merits had been so well expressed that he would only add that the gentleman who had been within a few minutes termed the "Grand Old Man" of Canada was a very warm friend of his own, and one for whom he had had the greatest admiration for many years. There was one pregnant sentence in the paper which sank into his heart, namely, that every loyal Canadian was a loyal subject of the British Crown. He hoped they might all emphasise that; because one did hear occasionally slight hints that the French-Canadians were not so. But in consequence of a visit he paid four years ago, at the invitation of a very distinguished friend of his, the late Principal Grant, he had travelled in the Province of Quebec, and he had the opportunity of seeing for himself many distinguished individuals connected with the French-Canadians, and he had just the same assurance continually made to him by them that were of the character which had been so well described by the eloquent author of the paper.

CANTOR LECTURES.

THE MEASUREMENT OF HIGH FREQUENCY CURRENTS AND ELECTRIC WAVES.

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

Lecture II.—Delivered December 4, 1905.

MEASUREMENT OF HIGH FREQUENCY CURRENT AND VOLTAGE.

If a condenser of any kind, such as a Leyden jar, is discharged through a low resistance, it is a familiar fact that the discharge does not consist in a single movement of electricity in one direction, but in a rapidly decreasing to-and-fro movement, called a train of electrical oscillatons. We can have this operation represented to the eye optically or photographically by means of a Duddell oscillograph, provided that we employ a capacity and inductance which are not too small.

The oscillograph is a kind of mirror galvanometer adapted to measure very rapidly changing currents. It consists of one or two loops of fine wire which carry a mirror, these loops being placed in a strong magnetic field (see Fig. 14). When an alternating current is passed through the wire it causes the mirror to vibrate to and fro, and a ray of light reflected from this mirror is also reflected from another mirror with axis at right angles, which is vibrating in tune with the first. The ray of light is then reflected either on to a ground-glass screen or a sensitive photographic plate. In order to render the instrument available for

FIG. 14.

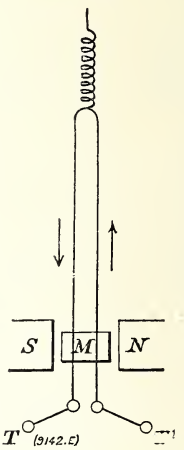
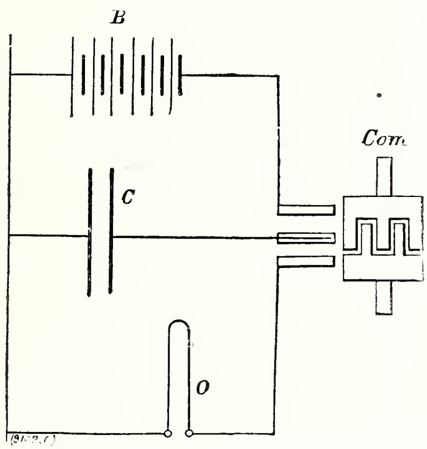


DIAGRAM OF DUDDELL OSCILLOGRAPH.

recording non-periodic phenomena, I have adopted the following plan :—On the shaft of an alternator having a frequency of about 80, is fixed a disc on non-conducting material having brass sectors let into it. Against this disc three brass wire brushes press, in such a fashion, that, as the alternator revolves, the middle brush is alternately connected, first to one and then to the other of the outside brushes for a time, equal to half a period of the alternator. If a condenser C, a battery of secondary cells B, and the oscillograph circuit O are connected up, as shown in diagram in Fig. 15, we can then employ the current

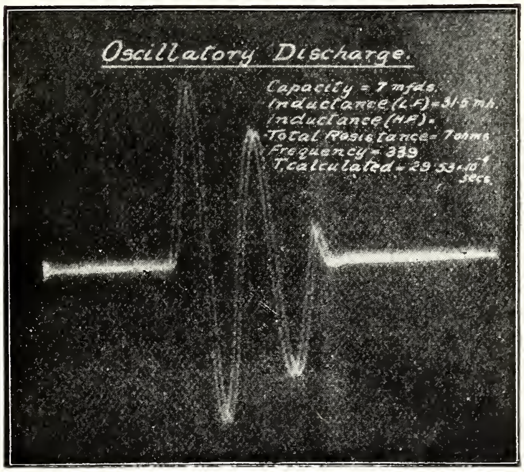
FIG. 15.



ARRANGEMENT FOR DELINEATING CONDENSER DISCHARGE CURVE.

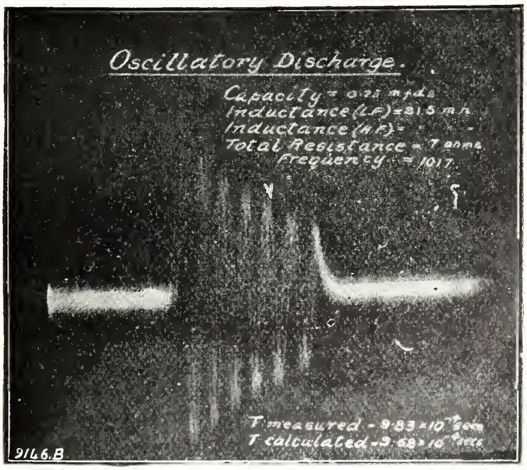
from the alternator to drive the mirror of the oscillograph, and at the same time use the alternator shaft to drive the commutator which alternately charges the condenser from the battery and discharges it through the oscillograph.* The result of this is we get on the screen of the oscillograph curves representing the oscillatory discharge of the condenser as seen in Figs. 16-20. These curves indicate that when the condenser discharges, the electricity rushes to and fro in the discharge circuit with a gradually decreasing amplitude, the oscillations decreasing in geometrical progression as the time increases in arithnetical progression. The capacity, inductance, and resistance in the circuit used are marked in each case on the diagram. The time interval between two successive zero points is called the semi-period of the oscillation, and the complete period is denoted by the letter T. The frequency, denoted by the letter n, is the number of periods per second. It can be shown by analysing these curves that two successive maxima in opposite

FIG. 16.



directions bear the same ratio to one another. In other words, if we can call I_1 I_2 I_3, &c., the successive maximum values of the currents, the ratio of I_1/I_2, I_2/I_3, &c., is constant. The logarithm of this ratio taken to the

FIG. 17.



Napierian base is called the logarithmic decrement, and denoted by the letter δ. If the amplitude of the oscillations dies away quickly, the oscillation is said to be highly damped, and if very slowly they are said to be slightly damped. If R is the total resistance

* In the actual experiments made in the Pender Electrical Laboratory, the time during which the condenser was in connection with the oscillograph was $\frac{66}{10000}$ of a second and the times of charge and discharge were not quite equal

of the circuit including the oscillograph, and L is the inductance, the ratio R/2L is called the damping factor, and denoted by the letter α. If C is the capacity of the condenser reckoned in microfarads, and L the in-inductance of the circuit in centimetres, then the quantity $\sqrt{CL}$ is called the oscillation constant of the circuit. It can be then shown that these quantities are connected by the following equations :—

$$T = \frac{1}{n} \quad p = 2\pi n = 6{\cdot}28n$$

$$\delta = \log_\epsilon \frac{I_1}{I_2} = \log_\epsilon \frac{I_2}{I_3} = \text{etc.}$$

$$\epsilon^\delta = \frac{I_1}{I_2} = \frac{I_2}{I_3} = \text{etc., where } \epsilon = 2.718$$

$$\alpha = R/2L = 2n\delta$$

$$T = \frac{2\pi}{\sqrt{\frac{1}{CL} - \alpha^2}} \text{ or } n = \frac{1}{2\pi\sqrt{CL}}$$

In making quantative measurements we must measure capacity in microfarads and inductance in centimetres, and then the formula for the frequency becomes—

$$n = \frac{5 \times 10^6}{\sqrt{C \text{ (in mfds)} \times L \text{ (in cms)}}}$$

and the expression for the oscillation constant O becomes—

$$O = \sqrt{CL} = \frac{5 \times 10^6}{n}$$

Also it can be shown that there is a certain relation between the first maximum ordinate I_1 of current, and the capacity of the condenser C the voltage V, to which it is charged and the frequency, which is expressed by the following formula—

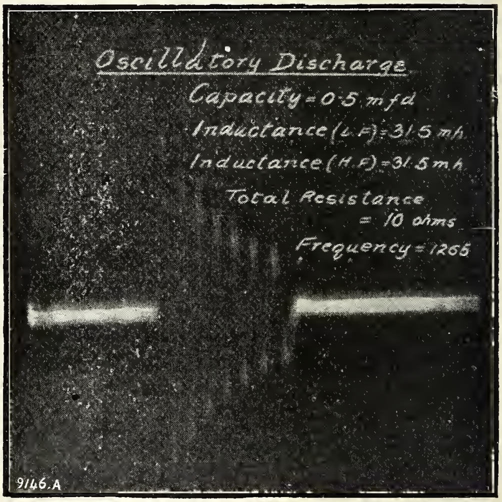
$$I_1 = \frac{C}{10^6} Vp$$

Where C is the capacity of the condenser in microfarads, V the voltage of the battery charging the condenser, and I_1 the first maximum value of the discharge current in amperes. The three important quantities in which we are concerned in considering the oscillatory discharge of the condenser are first, the frequency, n; secondly, the decrement, δ; and thirdly, the maximum amplitude, I_1. Again, we have to fix conventionally some limit beyond which we may consider the oscillations to be extinguished.

For all practical purposes we may consider the oscillations to be over when they are reduced to 1 per cent. of their initial value, It is then easy to show that the number of complete oscillations, M, in the group or train is given by the formula—

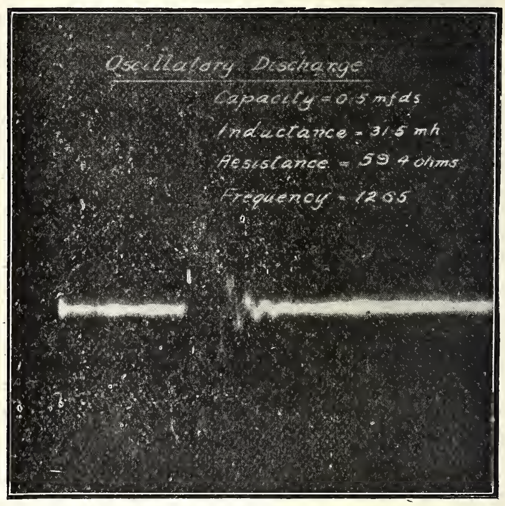
$$M \quad \frac{4.60\ 6 + \delta}{2\delta}$$

FIG. 18.



Suppose δ has any such a value of 0·1, which means that each oscillation is about 90 per cent. of the preceding one. This means that in 23 or 24 oscillations, the discharge is finished. If, however, δ equals ·01, then there

FIG. 19.

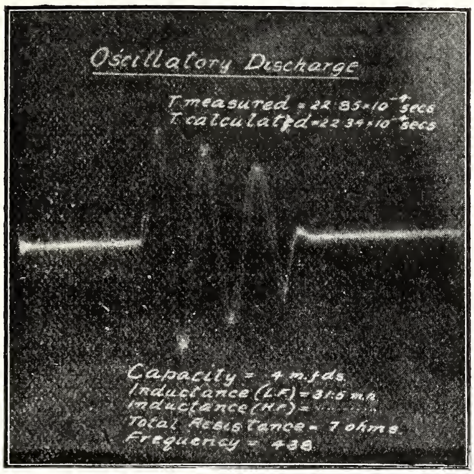


will be 230 to 240 complete oscillations in the train. In the case of oscillatory circuits as used in wireless telegraphy, in some cases there may not be half-a-dozen oscillations, in other cases as many as a thousand. As the operations of wireless telegraphy are greatly dependent upon the number of oscillations in

a train, the measurement of the decrement is very important. We are now in a position to analyse completely the events which take place when a Leyden jar is attached to the secondary terminals of an induction coil, and has a spark gap and inductance placed in series, with it forming an oscillatory circuit with the spark gap.

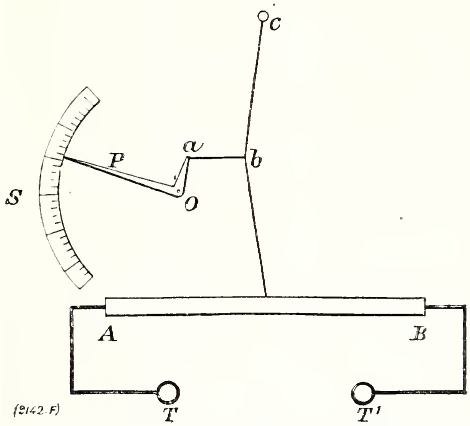
We are concerned with the following five quantities: first, the capacity, C, of the jar or condenser; second, the inductance, L, of the circuit; third, the maximum voltage, V, to which the jar is charged; fourth, the number of discharges per second, N; and fifth, with the mean square value of the current in the oscillatory circuit, J^2. In order to explain

FIG. 20.



the meaning of this last term, consider the oscillations in one single train to be sent through a fine wire, they would create a certain amount of heat in that wire, and if N groups of oscillations were sent through the wire in one second they would create N times as much heat in the wire. Supposing then that we pass through the wire continuous current having a certain value J, such that it would produce in that wire in one second the same quantity of heat as the N groups of the oscillations. The current J is called the root-mean-square value of oscillations. We can therefore find the value of J or the root-mean-square value of any train of oscillations by passing it through a hot wire ammeter provided this has a suitable form. In order that such an instrument may be available for making the above measurement, the wire which is heated must consist of either one fine wire not exceeding No. 36 in size or else a group of such wires in parallel, any suitable arrangement being made for measuring the expansion of the wire by heat, and therefore for graduating the instrument by means of a continuous current. I exhibit to you an instrument designed on these lines which I have had made. (See Fig. 21.)

FIG. 21.



HOT WIRE HIGH FREQUENCY AMMETER.

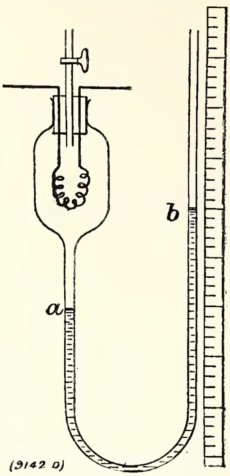
German investigators have made a good deal of use of a form of hot wire ammeter which is described in old books of electricity under the name of the Riess Electrical Thermometer. This instrument was, in fact, invented by our countryman, Sir W. Snow Harris, and was described by him in 1827 in the Philosophical Transactions of the Royal Society. In this instrument a fine wire or strand of fine wires is included in the bulb of an air thermometer consisting of a U-tube attached to a bulb, the bend of the tube being filled with some liquid. (See Fig. 22.) When a current is sent through the wire it heats the air and forces the liquid up in one leg of the U-tube until a stationary position is reached depending on the current. Such an instrument may be used for measuring the root-mean-square value of a train of oscillations, but my own experience is that it is not so useful or quick in operation as a hot wire ammeter made with a bundle of fine platinoid wires, the expansion of these wires being measured by means of the sag produced in them.

It is not difficult to show that there is a definite relation between the root-mean-square value of a train of oscillations, the maximum value I of the first oscillation, the logarithmic, decrement δ, and the frequency n, which is expressed by the following formula:—

$$J^2 = \frac{N I_1^2}{4a} = \frac{N I_1^2 L}{2R} = \frac{N I_1^2}{4n\delta}$$

Returning then to the Leyden jar discharge, we place a hot wire ammeter in the discharge circuit and also a spark counter, and make use of a discharger, consisting of two spark

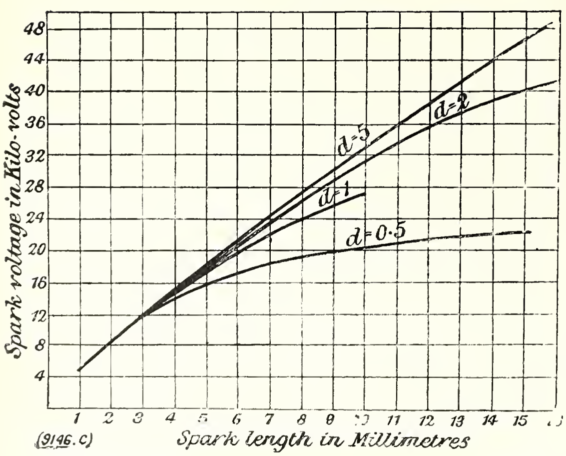
FIG. 22.



REISS OR SNOW HARRIS HOT WIRE AMMETER.

balls of steel, each ball being about 2 centimetres in diameter, the distance between the balls being adjustable and measurable by means of a micrometer screw. There is a definite relation between the voltage required

FIG. 23.



SPARK VOLTAGES FOR VARIOUS SPARK LENGTHS AND SPARK BALLS OF VARIOUS DIAMETERS d IN CMS.

to give a spark of any length in air at the normal pressure, and the size of the spark balls, which is given in Table IV. below, mostly taken from Heydweiller's observations of spark potential.* (See Fig. 23.)

* See A. Heydweiller, "On Spark Potentials." *Ann. der Physik*, Vol. 48, p. 235 (1898).

TABLE IV.

SHOWING THE SPARK VOLTAGE BETWEEN BRASS BALLS, 2 CENTIMETRES IN DIAMETER, FOR VARIOUS SPARK LENGTHS.

Spark length in cms.	Spark voltage.	Spark length in cms.	Spark voltage.
0·1	4,700	2·7	54,900
0·2	8,100	2·8	55,800
0·3	11,400	2·9	56,700
0 4	14,5C0	3·0	57,500
0·5	17,500	3·1	58·300
0·6	20,400	3·2	59,000
0·7	23,250	3.3	59,700
0·8	26,100	3 4	60,400
0·9	28,800	3·5	61,100
1·0	31,300	3·6	61,800
1·1	33,300	3·7	62,400
1·2	35,500	3·8	63,000
1·3	37,200	3·9	63,600
1·4	38,700	4·0	64,200
1·5	40,300	4·1	64,800
1·6	41,300	4·2	64,500
1·7	43,200	4·3	66,000
1·8	44,700	4·4	66,600
1·9	46,100	4·5	67,200
2·0	47,400	4·6	67,800
2·1	48,600	4·7	68,300
2·2	49,8C0	4·8	68,800
2·3	51,000	4·9	69,300
2·4	52,000	5·0	69,800
2·5	53,000	5·1	70,3C0
2·6	54,000		

Supposing, then, that we connect the secondary terminals of an induction coil to the spark balls, and also connect the spark balls by means of an oscillatory circuit consisting of an inductance coil, a condenser or Leyden jar, and an ammeter suitable for measuring high frequency currents made as described; also let us suppose that a strip of paper tape is drawn between the spark balls, as already described, so as to count the number of sparks per second, and let it be assumed also that we have already measured, as described, the capacity of the Leyden jar and the inductance of the circuit, we have then the means for measuring the above five mentioned quantities, C, L, V, J, R, and from these measured quantities we can deduce the value of others, viz., the frequency, n, the decrement δ, the resistance of the circuit, R, in ohms, and the number of oscillations per train, N, by the following formula :—

$$I_1 = \frac{C}{10^6} Vp = V \frac{\sqrt{C / 10^6}}{\sqrt{L / 10^9}} = V \sqrt{\frac{1{,}000\ C}{L}}$$

$$R = \frac{N L I_1^2}{2 \times 10^9 J^2} \qquad \delta = \frac{R\,10^9}{4\,n\,L}$$

$$M = \frac{4{,}606 \times \delta}{2\delta}$$

Where C the capacity is meaured in microfarads, V the charging voltage in volts, L the inductance in centimetres, J the root-mean-square current in amperes, and the resistance R is given in ohms.

Let us apply this to the case of the Leyden jar before us. The jar has a capacity of $\frac{1}{400}$th mfd, hence $C = 1/400$ mfd., the inductance L of the circuit $= 2{,}000$ cms., the spark length $=$ about 3 m.m., hence the voltage $V = 12{,}000$ volts, the number of sparks per second $N = 50$, and the R.M.S. value of the discharge current $= J = 1{\cdot}5$ amperes. We then find that the frequency $n = 2{\cdot}25 \times 10^6$ and the maximum current $I = 390$ amperes. The spark resistance $R = 3{\cdot}5$ ohms and the decrement $\delta = 0{\cdot}2$ and the number of oscillations per train $M = 24$.

Nothing is more astonishing than the large currents which can be given out by condensers of quite moderate size.

At one instant during its discharge this Leyden jar before you is furnishing a current of nearly 400 amperes, but of course that current lasts only for an infinitely small time. Supposing we desire to make a diagram to a scale representing what is taking place during one second when this Leyden jar is creating an oscillatory discharge, let us suppose that we take a scale of time on which one foot represents one millionth of a second, then a time of one second would be represented by a length of 200 miles. Again, let us suppose that we take a scale of current on which one millimetre represents one ampere, then we desire to represent a curve delineating the oscillations taking place in one second when this jar is discharged, we should have to draw a series of diagrams, each of which will resemble the one in Fig. 19, which would have to be placed four miles apart. Each train of twenty-four oscillations would be 4 feet 6 inches long, and the maximum ordinate, representing a current of 390 amperes, would be $15\frac{1}{2}$ inches, whilst the ordinate representing the root-mean-square current 7 would only be 1-5 of a millimetre.

You will notice, then, that the fifty groups of the oscillations taking place in one second only occupy in all 1-000 of a second, hence 999 thousandths of a second nothing is happening, and this explains how it is that the maximum current is so enormously greater than the root-mean-square current.

We must next consider some facts connected with the decay of oscillations in a train. The reason for this decay is evidently the dissipation of energy from some cause or causes. This dissipation may arise from any or all of the following causes:—

1. The resistance of the inductive circuit.
2. The resistance of the spark.
3. Magnetic hysteresis in the metal of the circuit.
4. Di-electric hysteresis or brush discharge or conduction in the condenser.
5. Radiation of energy from the circuit.

This last cause is generally the most important. In closed or nearly closed oscillatory circuits containing a spark gap, the decay of the oscillations is chiefly due to spark resistance, and generally speaking the resistance of the metallic part of a circuit is negligible compared with that of the spark. The decrement per semi-period may be of the order of ·01 or ·001. On the other hand in open oscillatory circuit, such as an Hertzian radiator or Marconi telegraphic aerial, it is found that the decrement per semi-period is much larger and may have the value ·1 or ·2 and this decay is not due to spark resistance, far less resistance of the wire, but chiefly due to the energy dissipated in the form of electric waves.

There are several methods by which this decrement may be determined, and it is essential to distinguish between that part of the decrement which is due to resistance, which is called the resistance decrement and that part due to radiation, which is called the radiation decrement.

Rutherford, Bjerknes and Drude have all devised methods for determining the decrement of electrical oscillations in a circuit. Rutherford's method depends on the principle that if a small bundle of soft iron wires, very fine and short, is magnetised to saturation, and then placed near an oscillatory circuit, it will be de-magnetised proportionately to the strength of the first oscillation, which is in the right direction. Since the oscillations alternately magnetise and de-magnetise the steel, and since the sum of a geometrical progression is proportionally to its first term, the integral effect is proportional to the magnitude of the first oscillation. Rutherford, therefore, arranged an apparatus, as follows:—Near the oscillatory circuit he placed a very small bundle of steel wires magnetised to saturation, and thereby

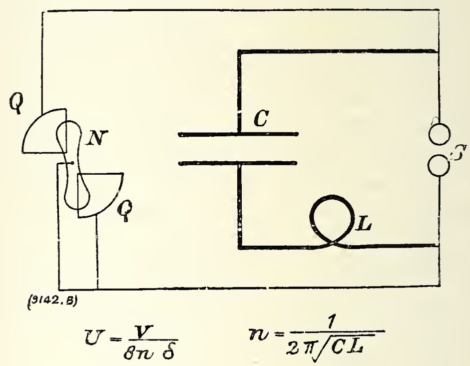
caused to deflect a magnetometer. He permitted the discharge to pass first in one direction, and then in another, by charging the condenser alternately in opposite directions, and noticed in each case the loss in magnetism of the small magnet. The ratio of these readings gives us the ratio of the first and second oscillations, and a Napierian logarithm of this ratio gives us the value of the decrement, δ. When there is no radiation, it can be shown that the decrement, δ, is equal to the quotient, R/2 L, where R is the resistance of the spark and circuit, and if the resistance of the metallic part of the circuit is small, we obtain the value of the spark resistance. Rutherford used this method to measure spark resistance, and also to prove that electrical oscillations are confined to the surface of a conductor. If the metallic part of the oscillatory circuit is made of iron wire, the value of the decrement is largely increased by reason of the hysteresis of the iron, but Rutherford found that the thinnest possible deposit of electrolytic copper put on the iron wire brings the decrement back to the same value as if the wire was solid copper.

Rutherford's experiments have been more recently repeated by Miss Brooks, and, amongst other things, she has been able to show that the light and the heat of the spark must be chiefly due to the impact of electrons against air molecules. Since the charge consists of a movement of electrons across the gap, and since we know the quantity of electrons moved, we know the number of electrons.

Miss Brooks has given a proof that more electrons are created by the spark than are necessary to carry the current across. This is no doubt due to the ionisation of the air molecules by electronic impact, and it is to the recombination of these ions that the heat and light of the spark are due.

The second method of obtaining the decrement is due to the Norwegian physicist Bjerknes. If we connect to the terminals of a condenser an electrostatic voltmeter, the readings of this voltmeter give us the root-mean-square value of the alternating voltage. (See Fig. 24.) If we measure the spark length, and determine from that the maximum voltage to which the condenser is charged, we can determine the ratio of this last quantity V to the root-mean-square value of the potential, U, and it can easily be shown that the ratio V/V = 4α = 2R/L. Hence from this ratio and the known value of the inductance of the circuit spark resistance can be determined. A third method, due to both Bjerknes and Drude, is based upon the use of what is called a resonance curve. (See Fig. 25.) It will be necessary to defer until the next lecture a full consideration of the nature and mode of delineation of such a curve, but

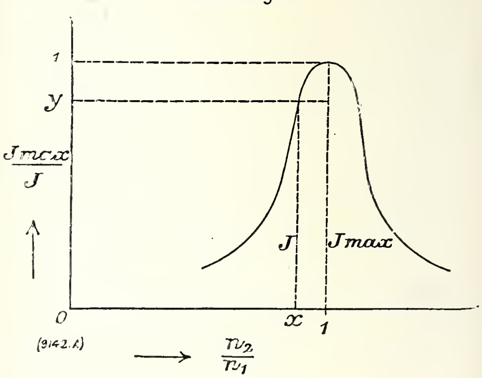
FIG. 24.



BJERKNES' USE OF QUADRANT ELECTROMETER TO MEASURE R.M.S. VALUE OF HIGH FREQUENCY VOLTAGE.

it affords a means of determining with great accuracy the decrement of a circuit, and hence the spark resistance if that circuit contains the spark gap. By the employment of this method Drude showed that for every condenser circuit containing a spark gap there

FIG. 25.



RESONANCE CURVE.

is a certain length of spark which gives minimum of damping, and also that zinc spark balls give less damping than iron or brass.

Another very important matter is the damping of a Hertzian radiator or Marconi aerial wire by radiation. Hertz gave a well-known formula by which this radiation decrement can be determined, and this can be applied to a wireless telegraph antenna of height h, and diameter d. The proof of this formula is long and difficult. It is as follows :—

$$\delta_r = \frac{\pi^3}{24 \log_e 2\, h/d} = \frac{0{\cdot}54}{\log_{10} 4\, h/d}$$

Thus, if the height of an aerial is 50 metres, and diameter $\frac{1}{10}$th of an inch, we find that the decrement has a value 0·12. This implies that there cannot be much more than a dozen complete oscillations in the case of the ordinary form of the plain aerial.

Another important practical measurement is the determination of the ratio of the energy dissipated in the spark of the energy radiated. When a plain Marconi aerial wire, having a spark gap at the bottom is charged and discharged, part of the energy is radiated as electric waves and part is expended in the spark. The efficiency of the antenna as radiator may be expressed as a percentage of the total energy. It can be shown that the energy radiated is to the energy expended of the spark in the ratio of the radiation decrement to the resistance decrement.

Taking a spark gap, say, of five millimetres in length for an ordinary plain aerial, the ratio of the radiation to the resistance decrement is about 10 to 1, and hence the radiation efficiency of the antenna is about 90 per cent. Supposing such an antenna has the capacity, say, of $\frac{1}{5000}$th of a microfarad and is charged to 15,000 volts, corresponding to a five millimetre spark gap 50 times per second, the power given to the aerial is only 1·25 watts and 90 per cent., and this is about 1 watt. Such an aerial can affect a suitable receiver 100 miles away. On the other hand, to supply such an aerial would involve the use of an induction coil taking, say, amperes at 16 volts, and therefore, although the efficiency of the antenna per is comparatively high, there is a considerable loss of energy somewhere else. This loss of energy takes place in the induction coil, and in the arc discharge which accompanies the spark of the induction coil, hence the moral is that the improvement of the efficiency of a wireless telegraph plant is to be looked for in an improvement in the efficiency of a spark-producing device.

OLD SILVER PLATE.*

From time immemorial silver has been in demand for the manufacture of vessels, ornaments, and decorations. So ductile is this metal that it can be drawn into strands twenty times finer than the finest human hair. There is therefore little wonder that this rare, beautiful, and malleable metal should be worked into objects which make the collecting of them one of the most fascinating of all pursuits. With the interesting subject of the various alloys and statute standards we have here little to do, and I shall only touch on the few points in this wide subject with which we come in contact in every-day life.

Most of our so-called pure silver, such as is used for vessels and ornaments, contains a little copper, by means of which alloy beautiful effects are obtained. The vessel is heated till it becomes dark in colour, caused by the formation of a thin coating of oxide of copper. If then covered with dilute sulphuric acid, the silver, where the acid has touched, turns beautifully white and frosted, owing to a coating of pure silver being left on the surface by the action of the acid in dissolving the copper film. This effect is most beautiful in objects having high relief where the bright and oxidised silver can be seen in contrast, with excellent results.

This oxidising has led to many frauds against collectors ; one of the easiest to perpetrate, and yet most difficult to detect, is the soldering of some small piece of genuine plate, bearing the leopard's head, or other authentic mark, on a modern imitation which is, perhaps, below the old standard of quality, and passing the whole lot off as a genuine antique. Should the surface be unoxidised, when the piece is well soldered, even an expert can seldom tell where the joint is without the blowpipe, and who will allow their cherished specimens to be subjected to this test ? How much more difficult must it be then to detect the fraud in a partly oxidised specimen. The antique specimens are also faithfully reproduced, the modern copy being subjected to various secret dodges which it would not be advisable to name here, and a cup, or other article of low quality made to-day, can, in a few moments, be made to represent a cup of the old, best style of plate, capable of deceiving an expert and selling for a fabulous sum. There are many tests by which the marks can be authenticated and the genuineness proved.

It may be said that if the collector has money, with patient care and a knowledge of the subject, with its dates, periods, styles, and marks, a reasonable number of genuine treasures may be obtained, which will prove a source of endless delight to everyone and to the collector in particular.

The various Statute marks are in themselves a fine study. The first mark was a leopard's head, being the King's mark of "silver of the sterling quality,"

* Communicated by Mr. John Mastin, R.B.A., F.R.M.S.

and showed a leopard's head bearing the crown. This was instituted in 1300, and not 1477 as mentioned in one of the Acts. In the famous "Pudsey" spoon of 1445, the head is crowned, and this is, we believe, the most ancient piece of plate known, bearing the English Hall mark.

In 1361 it was ordained by Statute that each maker should have a distinctive mark, which was to be placed on every article after being assayed and which he should be responsible for, the record of these marks being worth careful study.

For tampering with articles after being assayed, the penalty, in some cases, was death, but in spite of this these marks became much abused, being often put on articles below Statute quality. As a precaution, in 1438 a date letter was instituted which told when the article was made to within a year, and this took the form of a succession of alphabets, each being composed of twenty letters, arranged in various forms and devices, each distinct. Then came the Lion passant, in the year 1545 (or between 1540 and 1545), but very little plate is known between these dates. The Statute of 1696-7 improved the quality of silver, and the lion's head was erased, and the figure of Britannia substituted, but this did not last very long. Very few specimens of plate with this mark (after 1741) are known, owing to the restoration of the old quality of silver in 1720. It was a very common thing for specimens to bear both marks, and some of these are now in existence. This, as might have been expected, caused much confusion, and in 1784 the Sovereign's head was substituted. In addition to these marks, were those of various provincial assays.

Many rare specimens of old silver plate are in existence at the present time, perhaps the most prized being the famous "Pudsey spoon" and "Apostles'" spoons, copies of which have become so popular. Of the genuine sets, three of thirteen each are known to exist—no more; although there are several sets of ten and eleven. Many readers will know all about these, but it may perhaps interest some to have particulars of them:—(1) St. James the Less has a fuller's bat; (2) St. Bartholomew, a knife; (3) St. Peter, a fish or a key; (4) St. Jude, a cross, baton, or a square; (5) St. James (major), a staff or gourd, bottle, or roll, or bat; (6) St. Philip, a staff, cross or double cross, a small cross in his hand or bass of fish; (7) The Saviour, or "Master," has an orb or cross (this spoon is very rare indeed); (8) St. John has a cup; (9) St. Thomas, a spear or measure; (10) St. Matthew, a bag, axe, or spear; (11) St. Matthias, an axe; (12) St. Simon Zelotes, a saw; (13) St. Andrew, Saltire cross. Sometimes St. Paul, with one or two swords, is put in the place of St. Jude and other Apostles similarly changed.

Then there are the "Ardiger" spoons, date 1259, the thirteenth century pewter coffin chalice found at Cheam, the Nettlecombe chalice and paten, the unique and magnificent silver at the Corpus Christi, Trinity, Oriel, and All Soul's Colleges, Oxford; the Cirencester Communion Cup, flagon and paten; the superb collections of the Goldsmith's Company and Norwich Corporation, and that at the Ironmonger's-hall, Christ's Hospital, and Mercer's-hall; the unique mace of the Chesterfield Corporation, which is partly gold; the Goodwin Cup, and the most delightful work of Paul Lamerie.

The collecting of silver is like the taste or choice wines, and when one has taken it up seriously, there is no drawing back. He who has the time and money to spend in getting together a good collection, receives from it such stores of pleasure and delight as none but an enthusiast can understand.

[The writer acknowledges his use of some information obtained from "Cripp's English Plate."]

THE EMERALD MINES OF COLUMBIA.

The celebrated emerald mines of Muzo are owned by the Columbian Government, and are among its most valuable assets. An expert who has been employed by the Government of that country to examine and report upon them, states that these mines are situated in the State of Boyaca, and are about one and a-half hour's ride on mule-back from the small town of Muzo, which seems at present to be in a state of stagnation, but was formerly of considerable importance. Muzo can be reached by three days' hard riding over very bad roads from Zipaquira, the terminus of the Northern Railway, and about two hours railway journey from Bogota. The area of emerald-bearing ground at Muzo is very large; it has never been properly explored and tested, but it extends over many square leagues of country, the Government property alone which forms the district round the Muzo mines, being estimated at about 98,000 acres, of which a large portion is emerald-bearing. The mines have probably been worked for one thousand years. First by the Indians, then for some three hundred years by the Spaniards, and since then by various persons or syndicates under some arrangement with the Columbian Government. Most of these arrangements or leases were for short terms, and each person working the mines got out as many emeralds as possible, without regard to the future opening or working of the mine. As a result, each working party left the mine blocked with *débris* for their successors who, in turn, obtained what emeralds they could, without thinking of the future of the mine. Naturally under this system, although many emeralds were obtained, and some parties did well, the general output of gems was not large compared with what can be produced in the future with a better mode of working. Under great heat and pressure, due no doubt to volcanic action, these various minerals in the fissures or veins have crystallized in different shapes and forms, according

to the various minerals contained in any particular vein or fissure. Under favourable circumstances, the most beautiful deep green emeralds have been formed in these small veins. the green colour being undoubtedly due to the presence of chrome in sufficient quantity. In other veins the emeralds are found of a light green colour, due no doubt to the fact that there was not chrome enough present to give the deep green colour. Again, in other veins no chrome was present, and as a result the crystals are pure white or coloured red or yellow by oxide of iron. Many of the crystals are pure silica, and others have various minerals combined with the silica. Thus many kinds of crystals have been formed in the veins, according to the varying circumstances. The general tendency, however, in these emerald-bearing rocks is to form crystals of emerald of more or less green colour, and the quality of the emerald, if it is clear and free from flaws, depends upon its size and colour, the darker green being the most valuable. The present workings on the Muzo emerald mines are situated near the end of a long, deep valley, which end is shut in by a cross range into the valley. In the time of flood the water washes the *débris* from the mines down the valley, but in dry weather the force of the water is not sufficient to clear away the *débris* which soon accumulates, and may, in time, stop the working of the mine. The thickness of the emerald-bearing strata at the present workings of the Muzo mines varies from 100 to 200 feet. Although some emeralds are found in the upper strata, the amount is inconsiderable, and practically all the emeralds are found in the lower strata. It is stated by the expert that the production of the mines for the period included between May 1st, 1904, and January 31st, 1905, was as follows, stated in carats :—First-class emeralds, 262,548; second-class, 467,690; third-class, 22,700; fourth-class, 16,000. These figures give a total of 768,938 carats, sent to Bogota in the period named.

THE LIBRARY.

The following books have been presented to the Library since the last announcement :—

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Bright, Charles, F.R.S.E.—Submarine Telegraphs; their History, Construction and Working. London: Crosby Lockwood and Son. 1898. Presented by the Author.

British Rainfall, 1904.—Compiled by H. R. Mill, D.Sc., LL.D. London: E. Stanford, 1905. Presented by the Compiler.

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Zimmer, George F.—The Mechanical Handling of Material. London: Crosby Lockwood and Son. 1905. Presented by the Author.

HOME INDUSTRIES.

Commercial Agents and Home Industries.—In a recent number of the *Journal* (December 15), reference was made to the absence from the Greater Colonies of any official agent to report upon trade requirements. It was pointed out that whilst the Foreign and Colonial offices have officers in every Crown Colony and foreign country who forward annual reports upon the trade and commerce of their respective jurisdictions, no such reports come from Colonies with responsible Government, or from India. In a long letter which appears in *The Times*, of December 29, this anomalous state of things is discussed by Mr. F. C. T. O'Hara, Chief of the Commercial Agency Service, Department of Trade and Commerce, Ottawa. Mr. O'Hara says that "every Briton travelling in Canada is amazed when he is told there is not a single official appointed by the British Government throughout the Dominion, whose duty it is to report to London upon commercial matters for the benefit of the exporter of the United Kingdom." And yet there are 189 consular and trade agents of various ranks, appointed by the United States Government, scattered throughout Canada reporting to Washington regularly upon every conceivable topic of commercial information. And in minor degree the chief continental countries also have their agents in the Dominion. There are 16 from Germany, and 15 from France, 14 from Brazil, 10 each from Belgium, Italy, Portugal, and Spain, whilst between them Norway and Sweden have 33. Even Columbia, Greece, Hayti, have one each. It is only the United Kingdom that is without any representation at all. It seems inexplicable.

Foreign Agents and Competition. — The total imports into Canada from Great Britain in the last fiscal year amounted to £12,439,481, against £32,000,126 from the United States. Much of the balance in favour of America is no doubt due to geographical and other factors not to be displaced, but it is reasonable to assume that a larger proportion of Canadian trade would be secured to British exporters if Great Britain appointed commercial agents throughout the Dominion. As Mr. O'Hara points out, Canadian firms derive great advantage from the High Commissioner's office in London, and the four commercial agents kept by the Dominion Government in this country. The reports from the agents, and the High Commissioner's office, are published in the weekly reports issued by the Ottawa Department of Trade and Commerce, and are of great value. The United States trader again is guided in his efforts by the United States consular reports from Canada, and so with Germany, France, and other continental countries. All are assisted more or less by the official reports which are frequently made, and promptly published. The British exporter, on the other hand, is handicapped by being deprived of this information. Unless he sends out representatives, which is a costly procedure, and not always effective, he must work more or less in the dark. His Government gives him no help, for although the officials of the Board of Trade are always obliging, oftener than not they are unable to give any very detailed, or recent information, and so can only send a reply of a general, or doubtful, nature.

More Reports Wanted.—Another point referred to in the *Journal* was the need for more frequent publication of commercial information collected by Consular officers or others. In Mr. O'Hara's letter to *The Times* he mentions "the U.S. Daily Consular and State Reports distributed by mail free by thousands in every State of the American Union," and the "Weekly reports issued by the Department of Trade and Commerce" at Ottawa. Daily reports circulated gratis are not to be looked for from the Board of Trade, but it is not unreasonable to ask for much more frequent publication than takes place under the present system. There has been improvement in this direction but much remains to be done before all is done that might be done to assist the British exporter. Many of the Consular reports are very able documents, but they deal with a condition of affairs that may be radically changed before the report appears. That is unavoidable since they rest upon official statistics that are not available for months after the period to which they relate, but these annual reports from British Consuls in foreign countries, and British Governors in Crown Colonies, might be supplemented more frequently than they are by information of value to the home trader. It may be hoped that the new President of the Board of Trade will give his attention to the whole question. There is no reason to doubt that the Secretaries of State for Foreign and Colonial Affairs would readily co-operate with him by giving the necessary instructions to those whose duty it is to collect and transmit the required information.

Spinning Profits.—Figures have been published within the last few days relating to cotton spinning profits, which show that, for the last twelve months, they have been very large. They represent a return on the capital employed, including debentures, of nearly 13 per cent., or taking share capital only, of 19 per cent. Taking the balance-sheets of eighty-eight mills, representing a share capital of £3,500,000, and loans and mortgages of £1,750,000, with plant standing in the books at £4,280,000, and spindles numbering 7,320,000, the net profit shown is £674,960. How greatly the results in this industry vary is shown in the return of those same mills for the preceding three years. In 1904 the net profit was only £31,000, considerably less than one-twentieth of the 1905 profit; in 1903 there was no profit, but a loss of £45,000; and in 1902 there was also a loss, although it was only £1,400. The weaving trade, like the spinning, was very prosperous in 1904, and it is believed that the profits on looms were even larger than on spindles,

but few balance-sheets are published, and in their absence precise comparison is impossible.

Breweries and Consumption.—Whilst 1905 was a red-letter year for the cotton industry, breweries, which used to be the synonym for "wealth beyond the dreams of avarice," have been much less prosperous. Like the weavers, many of them are not very communicative as to their financial position, but the industry cannot be said to be very flourishing just now. One great brewery company has recently had to write off £2,389,000 of its capital, another, dating back to the early part of the last century, has had to leave its preference dividend unpaid; a third, larger and better known than either, has had to reconstruct, and is still within sight of the breakers. Many causes have contributed to this change in the position of the brewery interest. In the first place the consumption of beer *per capita* is diminishing. To take the last decade, the estimated consumption of beer per head of the population of the United Kingdom was 29·06 in 1894-5, 31·48 in 1900-01, and only 28·44 in 1904-5. To what extent this decrease is to be attributed to the growth of temperance, and bad times respectively, is a moot point. Probably, almost certainly, both causes have conduced to the result, and if, as is anticipated, 1906 sees greater trade activity, the figures of beer consumption for the year should throw some light on the question. But if there has been a diminution in the consumption of beer per head of the population in the ten years the total quantity sold has increased from 31,382,338 barrels in 1894-5 to 33,810,124 barrels in 1904-5. Yet far from the breweries increasing during the period under review there has been a notable decrease. In 1904-5 the number of licenses issued to brewers in the United Kingdom for sale was 9,050, in 1904-5 it had fallen to 5,311, whilst the decline in the practice of private brewing is shown by the fact that the number of licenses issued to brewers *not* for sale fell from 17,041 in 1894-5 to 9,930 in 1904-5.

Tied Houses and Competition.—Probably it is the buying of licenses with the object of making the publicans mere agents forbidden to sell the beers of other producers that has injured the brewing trade more than anything else. For years there was a wild scramble for tied houses, and the prices paid for them meant heavy loss. In order to find the necessary funds capital had to be inflated, but this was easy enough whilst the public were willing and eager to play into the hands of vendors and promoters by applying for shares, no matter how excessive the capitalisation. Disgusted for the moment with mining ventures, and the scandals that came of them, investors were persuaded that any sort of brewery must be a profitable enterprise, and the brewers themselves, with cheap capital and dear licenses, competed one against the other for licenses that could only spell loss having regard to the terms upon which they were got. Now, instead of capital being cheap it is dear, and licenses, instead of rising in value, have fallen. There will have to be a pretty general revaluation and writing down of assets to somehting near actual value, before brewery investments can stand again in public estimation where they did a dozen years ago. The tied house system has done no good to anyone. Taken as a whole, the brewers would have been much better off if they had left it alone, for after a time competition induced them to pay a price for control that left no room for adequate return; the system has gone far to kill the publican and substitute for him a mere bar manager; whilst the public has been the loser in that in the absence of wholesome competition there has been marked deterioration in the quality of the liquor consumed.

Shipping and Shipbuilding.—It looks as if the long depression in the shipping trade which commenced in 1901, is about to be followed by a period of renewed activity. The wastage of the Russo-Japanese war, which in one way and another is said to have cost some 400 millions sterling, must mean a large business to be done in replacement, and whether the goods are manufactured here or abroad, a majority of them must be carried in British bottoms, seeing that British ships exceed half the tonnage of the world. The previous over supply of tonnage, and the large quantity of new tonnage being built, have to be remembered, but when all allowances are made the outlook is more hopeful, notwithstanding the ever-growing rivalry of German lines. But new formations and organisations are in progress in German shipping which will make the task for British ship-owners of holding their own even more difficult than it is at present, and it seems likely that the American Ship Subsidy Bill, which the Senate Commerce Committee has favourably reported, will be passed. Should it be we must expect to see a considerable addition to the American mercantile marine. According to its friends the Bill will create a new fleet of from 200,000 to 300,000 tons of steel mail ships, a net addition to cargo (and fishery) tonnage of 1,500,000 tons, the creation of ten regular new or strengthened American steamship lines, supplemented by a large and active fleet of "tramp" or cargo vessels. But it is by no means certain that the Bill will become law this Session.

GENERAL NOTES.

Liège International Exhibition.—This Exhibition which was closed on November 6th, was visited by 6,143,157 persons. The receipts enabled 85 per cent. of the fund guaranteed to be returned. The Fine Arts building and the three new bridges over the Meuse, become the property of the city of Liège.

THE VIRGIN ISLANDS.—In his Report upon the Leeward Islands (Cd. 2684), the Acting Colonial Secretary, Mr. Jarvis, says that some progress has been made in inducing the peasants to cultivate cotton, but it is slow because incentive is wanting. The population of the islands is about 5,000, and is largely a seafaring one. The whole of the land is in the possession of negro peasant proprietors, who never feel the pinch of poverty. "The women do little work, the men can always get employment in connection with the shipping at St. Thomas, or earn good wages on the sugar estates in San Domingo." The negro is without ambition, and he has no white planters to imitate. "He leads a very isolated life, and it is extremely difficult to induce him to plant new crops, or adopt new methods of cultivation." More or less, this is the condition of the negro population in most of the smaller islands of the West Indies. A very little labour is enough to supply their wants, and the climate does not lend itself to exertion.

GERMAN COLONIES.—Mr. Whitehouse, Councillor of His Majesty's Embassy at Berlin, has made a very interesting report (Cd. 2682) upon German Colonies. The total expenditure for the administration of the German Colonies in Africa and the South Seas for the financial year 1904-5 was originally estimated at £1,243,000, but supplementary votes raised the sum to £5,078,000, the greater part of the increase being in connection with the South-West African rebellion, but includes the investment of £146,850 for the construction of the Lome-Paline railway in Togoland. In looking over the accounts of the various colonies the "Imperial grant" is never absent. For German East Africa it is £230,729 as against £302,572 for the preceding year; for the Cameroons it is £85,982 as against £68,765 for 1904; for Togoland it is an "Imperial loan" for construction of the Lome-Paline railway of £176,220; for German South-West Africa it is an "Imperial subsidy" of £2,604,747 as against £480,231 in 1904; for German New Guinea it is an Imperial subsidy of £41,727 against £44,422 in 1904, for the Caroline islands £7,886, for Samoa £10,875, for Kiao Chou £717,607 as against £615,938 in 1904. Apart from North-West Africa the development of the German colonies showed a modest but decided advance in the year under review, and the economic development of the colonies has been fairly satisfactory. The German Colonial Department congratulate themselves upon the fact that the aversion of the larger German capitalists to undertakings in the German colonies appears at last to be giving way, and that several private enterprises on a large scale have been initiated. Apart from the Otavi railway, a private firm has constructed and sent out a floating dock for Duala in the Cameroons, the North German Lloyd have constructed extensive harbour works at Simpson-Hafen in the Bismarck Archipelago, and two colonial banks have been established (the East African Bank for German East Africa, and the West African Bank for Togo and the Cameroons) which are in close touch with the leading financial institutions in Germany. But at present, and apart from the war expenditure, the German colonies represent a somewhat heavy drain upon the Imperial Treasury.

SWISS TRADE WITH THE UNITED KINGDOM.—The United Kingdom continues to be Switzerland's principal market for her manufactured goods, and in 1904 she took 21·9 per cent. of the Swiss exports, the principal articles being silk and cotton goods, watches, ironware, and machinery, condensed milk—to the value of £695,800; chocolate—to the value of £451,600; woollen goods, pharmaceutical preparations, chemicals and colouring materials, boots and shoes, and straw goods, amounting in all to £6,598,700; or if the exports to British India, Canada, and Australasia are added, to £7,830,700. In his report upon Swiss trade, just issued, the British Commercial Agent in Switzerland says that Swiss manufacturers complain that the British market is not what it was as regards prices. Formerly only goods of superior quality were asked for, but cheaper and inferior silks are more and more superseding the better article, and the chief point with the purchaser now seems to be a low-priced quality. It would be interesting to know if this tendency is observed elsewhere. Be that as it may, there would seem to be unnecessary disparity between the exports of Switzerland to the United Kingdom, and those of the United Kingdom to Switzerland. Whilst we took last year £6,598,700, Switzerland took from us only £2,301,000. On the other hand, British India, Canada, and Australasia which took £1,232,000 from Switzerland, sent her £852,000 in return. Swiss manufacturers seem anxious to do more business with the United Kingdom, and the growing demand for printed goods in Switzerland suggests that expansion is practicable.

BAHAMAS SPONGE FISHERIES. — Some figures quoted by the Govenor of the Bahamas, in his report on the Blue-book of the Bahamas for 1904-5 (Cd. 2684), give an idea of the extent of the sponge fishery business carried on in those waters. There were 265 schooners of from 5 to 43 tons burden, and 322 sloops of from 1 to 16 tons burden with an aggregate tonnage of 5,952. Attached to the vessels were 2,517 open boats, and 5,517 men and boys were employed on them. In addition to the above, there were 291 open boats engaged, manned by the owners living on the coasts of several of the out-islands to the number of 445. Much alarm has been felt respecting the future prospects of this industry, which is of so great economic importance to the colony. Disquieting reports as to the exhaustion of the sponge beds and the increasing quantities of small sponges brought to market, which should have been left in the beds to grow to a proper marketable size, led to the enactment of a law under which a Sponge

Fisheries Board is established with certain powers for the regulation of the fisheries, and provided with a small annual grant for expenses. Recently, as appears from the annual report of the Board to the Governor and Legislature, the Bight of Abaco has been examined, and the result fully confirms the suspicions previously entertained. The report states that the beds are thickly sown with small sponges which are constantly being gathered by the itinerant fishermen who are continually working over these fields pulling all the sponge they can find without regard to size or quality, in consequence of which there are very few large sponges to be found anywhere. The spongers living in the settlements all round the coast are in sympathy with the movement for protecting the industry against the wasteful methods complained of, and will welcome any reasonable laws for the protection of the young sponge.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 17.—"The Scientific Aspects of Voice Development." By WILLIAM A. AIKIN, M.D.

JANUARY 24.—"The Planting of Waste Lands for Profit." By DR. J. NISBET.

JANUARY 31—"The Garden City and the Cheap Cottage." By THOMAS ADAMS.

FEBRUARY 7.—"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E. SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

FEBRUARY 14.—"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON. COLONEL H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 21.—"The Fisheries of the North Sea." By WALTER GARSTANG, M.A. EDWIN RAY LANKESTER, M.A., LL.D., F.R.S., will preside.

FEBRUARY 28.—"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.). SIR JOHN WOLFE-BARRY, K.C.B., LL.D., F.R.S., will preside.

Dates to be hereafter announced:—

"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.

"Submarine Signalling." By J. B. MILLET.

"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"Industrial Russia." By LUCIEN WOLF.

"The Artistic in Painting and Photography." By J. C. DOLLMAN, R.I.

"Motor Boats." By BERNARD B. REDWOOD, B.A.

"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT.

"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 18.—"The City of Calcutta." By CHARLES EDWARD BUCKLAND, C.I.E.

FEBRUARY 15.—"The Navigable Waterways of India." By ROBERT BURTON BUCKLEY, C.S.I.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

FEBRUARY 6.—"Imperial Immigration." By OCTAVIUS CHARLES BEALE, President of the Federal Council of the Chambers of Manufactures of Australia.

MARCH 6.—"Imperial Questions in the West Indies." By SIR NEVILE LUBBOCK, K.C.M.G.

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

JANUARY 30.—"Chemistry of the Painter's Palette." By J. M. THOMPSON, LL.D., F.R.S.

FEBRUARY 20.—"Illuminated Manuscripts." By H. YATES THOMPSON, F.S.A.

MARCH 20.—"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A.

APRIL 24.—"Cut Glass." By HARRY POWELL.

MAY 24.—"Basket Making." By THOMAS OKEY.

JUVENILE LECTURES.

Two lectures suitable for a Juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, 1906, at 7 o'clock, by PROFESSOR HERBERT JACKSON, on "Combustion and Flame."

LECTURE II.—JANUARY 10.—Nature of flame—Luminous and non-luminous flames—Sources of light in flames—Effect of inert gases—Shadows cast by flame—Light without combustion—Luminosity in gases and in solids—Solids introduced into flames—Light and heat from rapid vibrations—Noises from flames.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." Five Lectures.

LECTURE I.—JANUARY 29.—Characteristic features of warships—Materials of construction—Structural arrangements—Operations of building and launching.

LECTURE II.—FEBRUARY 5.—Armour protection—Systems of disposition—Methods of manufacturing armour plates—Recent improvements in quality, and consequent changes in designs of warships.

LECTURE III.—FEBRUARY 12.—Armaments—Progress in the design and manufacture of guns, mountings and machinery for working heavy guns—Improvements in projectiles and explosives.

LECTURES IV. AND V.—FEBRUARY 19 and 26.—Recent types of warships, British and Foreign—Battleships — Armoured and protected cruisers—Scouts—Torpedo boats and destroyers—Submarines.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

HOWARD LECTURES.

Thursday evenings, at 8 o'clock :—

PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., "High Speed Electric Machinery, with special reference to Steam-Turbine Machines." (Three Lectures.)

LECTURE I.—JANUARY 18.—*The Problems of Electric Design as affected by Speed and rated Output.*—Economic generation of electric energy dependent on cost of prime power, on type of prime mover, and on design of electric generator—Slow-speed generators developed on Continent and in United States to suit slow-speed engines, or for coupling to water-turbines—High-speed engines developed in England to suit high-speed generators—More recently the use of motor generators and of steam-turbines has emphasized the development of new forms of generators suitable for very high speeds—Output of an electric generator dependent on iron, copper, speed, and insulation—Dependence of design on "factors of utilisation"—Conception of the "active belt"—Efficiency—Energy-losses in different parts—Ventilation—Regulation— Frequency—Commutation—Relation of surface-speed to design—Limits of design as to (1) strength of materials, (2) permissible temperature-rise, (3) sparkless commutation—Output rules—Examples of low-speed design—Examples of high-speed design.

LECTURE II.—JANUARY 25.—*Turbo-dynamos.*—The problem of commutation—Use of carbon brushes and of metal brushes—Natural and forced commutation—Peripheral speed in relation to commutation—Loading of armatures — Armature distortion—Limits of design as affected by permissible temperature-rise and by sparkless commutation under all loads—Problem of centrifugal forces as affecting dynamo design—Turbo-dynamo designs.

LECTURE III.—FEBRUARY 1.—*Turbo-alternators.*—Relation between frequency, number of poles, and revolutions per minute—Relation between frequency, surface-speed, and pole-pitch—Turbine speeds and field-magnet design — The limitations of magnet design — Balancing — Armature-design in alternators — Nature of armature reaction—Armature-design as affected by power-factor of the load—Mechanical considerations — Ventilation of turbo-alternators—Forced ventilation—Efficiency; overload possibilities; limits of design—Excitation of field-magnet system—Preference given to very low voltage of excitation—Examples of turbo-alternators.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 8...Chemical Industry (London Section), Burlington-house, 8 p m. 1. Mr. David Howard, "Cinchona Barks and their Cultivation." 2. Mr. S. M. J. Auld, "A New Method for the Quantitative Estimation of Acetone."

Medical, 11, Chandos-street, W., $8\frac{1}{2}$ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. W. Evans Darby, "Shakespeare's 'Tempest': A Study of Present-day Problems."

Tramways and Light Railways Association, 25, Great George-street, S.W., 8 p.m. Mr. A. L. C. Fell, "Brakes."

TUESDAY, JAN. 9...Hellenic Studies, in the Rooms of the Society of Antiquaries, Burlington-house, 5 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. H. H. Turner, "Astronomy." (Juvenile Lecture VI.)

Medical and Chirurgical, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.

Civil Engineers, 25, Great George street, S.W., 8 p.m. 1. Mr. David Ernest Lloyd-Davies, "The Elimination of Storm-water from Sewerage Systems." 2. Lieut-Colonel Alfred Stowell Jones and Dr. William Owen Travis, "The Elimination of Suspended Solids and Colloidal Matters from Sewage."

Anthropological, 3, Hanover-square, W., $8\frac{1}{2}$ p.m.

Association of Engineers-in-Charge, St. Bride's Institute, Bride-lane, E.C., 8 p.m. Mr. F. Crawter, "Storage Batteries and their Application to Public Institutions."

WEDNESDAY, JAN. 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 7 p.m. Prof. Herbert Jackson, "Combustion and Flame." (Juvenile Lecture II.)

Biblical Archæology, 37, Great Russell-street, W.C., 8 p.m. Annual Meeting.

Geological, Burlington-house, W., 8 p.m.

Japan Society, 20, Hanover-square, W., $8\frac{1}{2}$ p.m. Miss Ethel McCaul, "The Red Cross Society of Japan."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, JAN. 11...Antiquaries, Burlington-house, W., $8\frac{1}{2}$ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Prof. E. Markham Lee, "Richard Strauss and his Works."

Electrical Engineers, 25, Great George-street, S.W., 8 p m. Discussion on Mr. W. H. Patchell's paper "The Charing Cross Company's City of London Works."

Mathematical, 22, Albemarle-street, W., $5\frac{1}{2}$ p.m.

FRIDAY, JAN. 12...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Prof. John Dewar Cormack, "The Theory of Machines."

Astronomical, Burlington-house, W., 8 p.m.

Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.

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FRIDAY, JANUARY 12, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 17, 8 p.m. (Ordinary Meeting). WILLIAM A. AIKIN, M.D., "The Scientific Aspects of Voice Development."

THURSDAY, JANUARY 18, 4.30 p.m. (Indian Section). CHARLES EDWARD BUCKLAND, C.I.E., "The City of Calcutta."

THURSDAY, JANUARY 18, 8 p.m. (Howard Lecture). PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., "High Speed Electric Machinery with Special Reference to Steam Turbine Machines." (Lecture I.)

Further details of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

On Wednesday evening, January 10th, Professor Herbert Jackson, F.I.C., delivered the second and last lecture of his course of Juvenile Lectures on "Combustion and Flame."

The lecturer commenced with a description of the conditions favourable to combustion which had been indicated at the close of the first lecture. The influence of porous bodies and of substances such as platinum which have distinct chemical relations to oxygen, hydrogen, and hydro-carbons, was described and illustrated by experiments. It was explained that the condensation both of oxygen and the combustible gases associated with the porous character of platinum in a fine state of division brought about that close contact of the gases with oxygen which was a necessary condition of their combination. At the same time the actual affinity of platinum for each of the reacting substances played an important part.

Raising the temperature of bodies and so augmenting the rapidity of movement of their individual particles would have the effect of virtually bringing about the desired contact by increasing the number of possible collisions provided the freedom of movement were sufficient. The different temperatures required to bring this about with varying substances was illustrated by showing the relative ignition points of coal gas, the vapour of carbon bisulphide and silicon hydride. The influence of contact with cold bodies was shown, and the importance of the practical application of this influence in the use of wire gauze in safety burners and lamps was referred to and explained.

The lecturer then dealt with the structure of flames, and pointed out that the possible variations in structure could be ascribed simply to the conditions of the production of the flames. When the reacting gases were equally distributed and intimately mixed a flame of a homogeneous character would result, and this was illustrated by burning an intimate mixture of nitric oxide and the vapour of carbon bisulphide. If, however, as in many cases, the combustible gases issued from an orifice into the air, then the mechanical manner of their admixture with the air would determine the local proportions of unburnt and burning gases, and give rise to the usual excess of the former near and about the orifice. The hollow nature of such flames was therefore illustrated by experiment, and the lecturer then turned to the subject of the conditions affecting the luminosity of flames. It was shown that the idea of more perfect combus-

tion would not alone explain the absence of light in the well-known Bunsen burner, since by using pure oxygen in much greater quantity than its air equivalent the luminosity of the coal-gas flame was by no means extinguished. It was shown as the converse of this experiment that inert gases such as nitrogen or carbon dioxide would destroy the luminosity of flames although the amount of actual combustion was greatly decreased. By increase of pressure non-luminous flames such as those of hydrogen and alcohol become luminous. This was illustrated, and the lecturer then proceeded to deal with the whole question of luminosity in flames. The undoubted presence of solid particles in some flames and their absence in other equally luminous flames was shown and described. The influence of pressure and temperature on the luminosity of flames was explained in detail, and experiments were then shown to illustrate tbe generalisation which the lecturer put forward, viz., that there were movements in flames, whether considered as oscillations of molecules, atoms, or electrons, too rapid to give impressions to our eyes, but which when interfered with or stopped by particles of a more complex character gave rise to such movements of these particles or their contents as in turn to produce ethereal waves of light either restricted in colour or containing all colours as in white light. The real nature of luminosity in flames differed, therefore, only but little from that of luminosity produced in any other way in which the light arose, from the stoppage of other and more rapid movement, or from the response on the part of complex particles to the extremely rapid oscillations or movements of particles of much greater simplicity. This general view of the nature of flames and of the necessity of providing complex particles capable of taking up and converting the extremely rapid invisible oscillations of the flame into visible ones was illustrated by experiments specially arranged for this purpose. The necessity of recognising that the light of flames depended as much on this sensitive response of the solids or complex vapours in the flame, as on temperature as ordinarily understood, was insisted upon.

The lecturer concluded with a reference to sensitive and singing flames.

The CHAIRMAN proposed a hearty vote of thanks to Professor Herbert Jackson for his interesting course of lectures, which was carried unanimously.

CANTOR LECTURES.

THE MEASUREMENT OF HIGH FREQUENCY CURRENTS AND ELECTRIC WAVES.

By Professor J. A. Fleming, M.A., D.Sc., F.R.S.

Lecture III.—Delivered December 11, 1905.

Measurement of Frequency and Resonance.

We have seen in previous lectures that every electrical circuit containing a condenser and inductance when charged and discharged executes electrical oscillations with a certain definite period depending on the capacity and inductance. The circuit may, therefore, be compared to a pendulum which has a periodic time depending on its length. Suppose that we have two such oscillatory circuits placed near to each other in the right position, oscillations set up in one circuit will induce oscillations in the other circuit, and the circuits are said to be inductively coupled. They exercise a mutual action and reaction, and may be compared to two pendulums coupled together mechanically. Thus, for instance, suppose we have two pendulums of equal length hanging from a loose cross string, and that we set one pendulum swinging, it imparts little jerks to the cross string, and if the other pendulum has the same time period, this last will gradually be set in motion. But since action and reaction are equal and opposite, the driving pendulum must retard itself just as much as it accelerates its colleague, and therefore the energy is passed backwards and forwards, hence the pendulum that was started in motion is gradually brought to rest and the other one that was at rest is gradually set in motion. These states of rest and motion alternate for each pendulum. Two such coupled pendulums are called syntonic pendulums when they have the same time period or when one pendulum has a period which is the harmonic of the other. The same experiment may be shown with two pendulums, one of which is double the length of the other. It will not succeed, however, unless the natural time periods of the two pendulums are either equal or in some integer ratio. Similarly two electric circuits when inductively coupled act and react on each other if their time periods are equal, or in integer ratio.

Returning to the pendulums, let us suppose

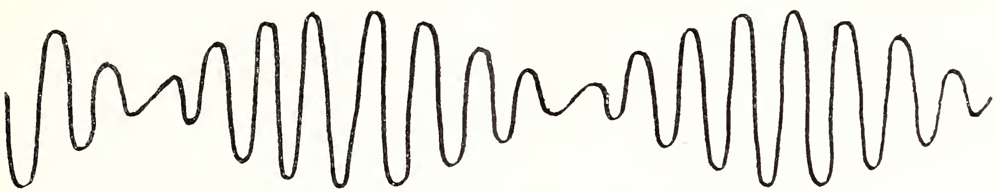
that we take a trace of the motion of the bob of each pendulum, by causing it to mark its vibrations on a strip of paper which is moved uniformly across its motion. We should obtain a curve for each, similar to that in Fig. 26, waxing and waning as the amplitude of the pendulum motion is increased, and decreased.

It is a well-known fact that such a curve as that shown in Fig. 26, is the resultant of two simple harmonic motions of slightly different period, and it is the graphic representation of the audible effect called beats in music, due to the simultaneous action of two sources of sound, say two organ pipes slightly out of tune with each other. Hence we may resolve the waxing and waning motion of each of the coupled pendulums into the sum of two simple harmonic motions of different period. Therefore the effect of coupling two pendulums of equal time period is to generate in each of them by their mutual re-action, a compound oscillation, composed of two vibrations of different periods. The same thing holds good in the case of two electric oscillatory circuits or a pair of coupled circuits constituting an oscillation transformer. These are said to be closely or loosely coupled according as their mutual induction is large or small, the coefficient of coupling denoted by the letter k being equal to $M / \sqrt{LN}$, where M is the mutual inductance of the two circuits, and L and N are the inductances of the two separate circuits.

Suppose then we have two such circuits inductively coupled, and electric oscillations are set up in one of these circuits by introducing a spark gap into it and charging the primary condenser by means of an induction coil. We may so adjust the inductance and capacity of the other circuit that it has the same time period, and the circuits are then said to be syntonised or tuned.

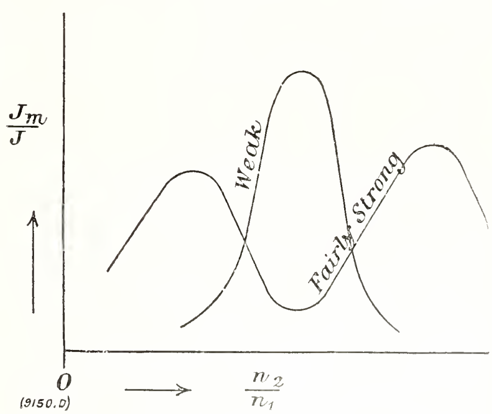
If we introduce into the secondary circuit a hot wire ammeter, and measure the effective value of the current in the secondary circuit, we find that in proportion as the secondary circuit is brought into tune with the primary circuit, so does this secondary current increase up to a maximum value which is called the resonance value. We can plot a curve called a resonance curve, ordinates of which represent the ratio of the maximum or resonance current to any other current and corresponding abscissæ represent the ratio of the natural frequencies of the two circuits (see Fig. 27). The form of this resonance curve will depend upon the nature of the coupling. If the coupling is very weak, then the resonance curve has one maximum value. If the coupling is stronger, then it has two maxima like the hump of a dromedary camel. When the tuning of the two circuits is not quite exact, theory shows that there are two sets of superimposed oscillations in the circuit. The resultant oscillation is the sum of these two. When the two circuits are not strongly coupled and are tuned to the same period n_0, then it can be shown that the frequencies n_1 and n_2 of the two resultant oscillations in the secondary circuit are given by the formulæ—

FIG. 26.



CURVE COMPOUNDED OF TWO SIMPLE PERIODIC CURVES OF SLIGHTLY DIFFERENT WAVE LENGTHS.

FIG. 27.



RESONANCE CURVES.

$$n_1 = n_0 \frac{1}{\sqrt{1 - k}}$$

$$n_2 = n_0 \frac{1}{\sqrt{1 + k}}$$

where $k = M / \sqrt{LN}$

and accordingly we have

$$n_1^2 + n_2^2 = 2n_0^2$$

$$k = \frac{n_1^2 + n_2^2}{n_1^2 - n_2^2}$$

To illustrate and investigate these facts I have devised an instrument called the cymometer, which has proved itself to be exceedingly useful in connection with high frequency measurements. The principle on which this cymometer is constructed, is as follows :—

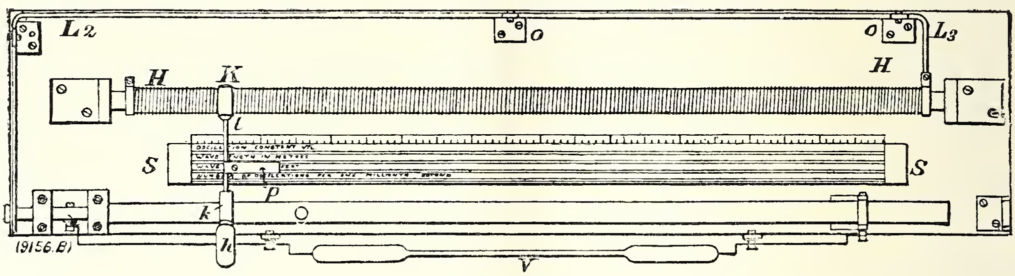
are varied simultaneously and in the same proportion by one movement of a handle.

One vacuum tube consisting of a tube of uranium glass filled with rarefied carbonic dioxide is supplied with the instrument, but by special arrangement a tube filled with the rare gas Neon, can be supplied. The Neon vacuum tube, as I have shown, is far more sensitive than any other form of vacuum tube, and its glow is so brilliant that it can be seen in a large room in broad daylight.

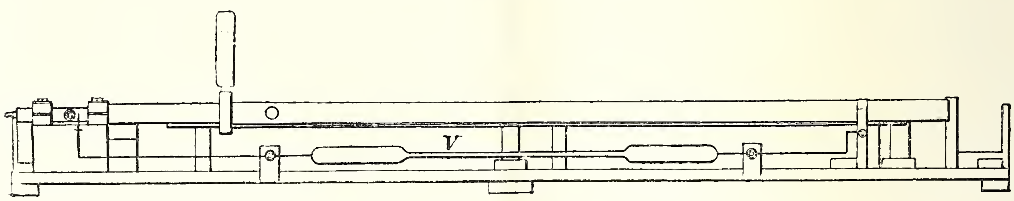
The instrument is employed in the following manner :—

1. *To Determine the Frequency of the Electric Oscillations in any Circuit.*—Place the cymometer so that the copper bar L_2 L_3 is

FIG. 28.



FLEMING CYMOMETER (PLAN).



ELEVATION.

It consists (see Fig. 28) of a sliding tubular condenser, formed of two brass tubes separated by an ebonite tube. The outer tube can be moved by a handle, *h*, and an index pointer, P, moves with it over a divided scale, SS. Parallel with the condenser is an inductance coil, H, H, consisting of bare copper wire, wound on an ebonite tube. From the outer tube of the condenser, O, a pin, *l*, having a crutch end, lies on the inductance, and the circuit is completed by a copper bar L_2, L_3, of square section. With the instrument is supplied a vacuum tube, V, which is attached to two small hooks placed on the ends of copper wires, which are respectively in connection with the outer and inner tubes of the condenser. The special characteristic of this instrument is that its inductance and capacity

parallel with, and close to any straight portion of the circuit in which electric oscillations are taking place. Then fix the vacuum tube to the two small hooks in connection with the terminals connected to the inner and outer brass tubes forming the condenser, and screw the ebonite handle into the thick collar, *k*, of the outer tube of the sliding condenser. Move the handle, thus sliding the outer tube of the condenser along, until the vacuum tube glows most brightly. Then the end of the index, P, will indicate on the lowest of the four scales the number of oscillations in one-millionth of a second. Thus, suppose it reads 3·5. This indicates that the frequency of the oscillations is 3·5 millions. Also the top scale reading indicates the *oscillation constant* of the circuit being tested, viz. : the square root of the

product of the capacity in microfarads and inductance in centimetres of the cymometer circuit in the position in which it is at that instant, and therefore of any other circuit which is loosely coupled and in resonance with it. If then we know either the inductance of the capacity of that circuit, we can determine the second quantity. The range of the oscillation constant for the instrument illustrated is from 0 to 12. The frequency of the oscillations is connected with the oscillation constant by the rule, Frequency = $5{\cdot}033 \times 10_6$ divided by the oscillation constant. Hence the product of the oscillation constant as recorded on the scale, and the number of oscillations in one millionth of a second is almost exactly equal to the number 5.

2. *To Determine the Capacity of a Leyden Jar.*—In the lid of the box containing the cymometer is provided a rectangular circuit of insulated wire, the inductance of which is 5,000 centimetres. The rectangle has two tails of wire. It is used as follows:—Set up an induction coil and place the secondary spark balls within a few millimetres of each other. Join one pair of ends of the rectangle of wire to these spark balls. At the other end connect the tails of wire to the innner and outer coatings of the jar to be tested. (Insulate the jar.) Then slide the outer tube of the condenser of the cymometer along until the vacuum tube glows most brightly. Observe on the scale the corresponding reading, marked "oscillation constant." Square this number and divide by 5,000, the resulting quotient is the capacity of the Leyden jar in fractions of a microfarad. The size of capacity which can be measured is determined by the range of the cymometer. In the instrument before you that range covers oscillation constants from 1 to 12.

3. *To Determine the Inductance of a Coil of Wire.*—Determine in the above manner the capacity of a small Leyden jar, say, one having a capacity of about $\frac{1}{700}$th of a microfarad. Then insert in the circuit in series with the rectangle of wire, the piece of wire or coil of which the inductance is required. Move the handle of the cymometer until the vacuum tube shines again most brightly. Observe in each case the reading of the oscillation constant on the scale. Square these numbers and take their differences and divide by the capacity of the Leyden jar, reckoned in microfarads. The quotient is the inductance of the piece of wire in centimetres. Thus, suppose the capacity of the Leyden jar to be $\frac{1}{500}$th of a microfarad, and suppose that in the first case the oscillation constant is found to be 2, and in the second case it is found to be 7, the difference of the squares is then 45, and the inductance of the piece of wire would then be 22,500 centimetres. In this manner an inductance up to about 70,000 centimetres or 80,000 centimetres, that is 70 or 80 microhenrys, can be measured.

A variety of other measurements can be made with the cymometer, which will suggest themselves if it is remembered that when the cymometer bar is placed parallel and near to any circuit in which oscillations are taking place, which has, therefore, capacity and inductance, the scale reading when the vacuum tube glows most brightly, taken on the scale marked "oscillation constant," gives the square root of the product of the capacity reckoned in microfarads, and the inductance reckoned in centimetres of the circuit being tested.

The cymometer is most valuable as a teaching instrument to illustrate to a class or audience the laws of electrical resonance and the phenomena connected with the inductive production of electrical oscillations. It is in fact as useful in connection with high frequency oscillations as a Wheatstone's Bridge or Potentiometer is in relation to the measurement of continuous electrical currents.

The cymometer is contained in a strong wood box fitted with handles. In the lid of this box the standard inductance is fixed.

The over-all dimensions of the instrument are: Length, 4 feet 6 inches = 136 cms.; width, 1 foot = 30 cms.; depth (with handle unscrewed), 6 inches = 15 cms.

We may employ this cymometer to prove the statement just made that in the case of two coupled circuits, oscillations of two frequencies are set up if they have the same natural time period. I have before me two rectangular circuits, each of which contains a Leyden jar, the two circuits have the same inductance and the same capacity, one of these circuits contains a spark gap and we set up oscillations in it in the usual manner by an induction coil. When this is done, if we apply the cymometer to both these circuits, putting the bar of the cymometer first parallel to the secondary circuit and then parallel to the primary circuit, we find that in each of these circuits there are two oscillations, and that the vacuum tube of the cymometer illuminates itself for two positions of the handle of the cymometer. We can determine the natural period of vibration of each of the

circuits by removing the secondary circuit and employing the cymometer in the above-described manner to measure the oscillations of one single frequency, then occurring in the primary circuit. We then find that the frequency of these two oscillations and also that of the natural oscillation are different, and comply with the formula given above; one of these oscillations in the coupled circuits has a greater value, and the other has a lesser value than the natural frequency of both the circuits taken separately.

We can also employ this cymometer to determine the oscillations in a wireless telegraph antenna, as follows:—

Place the cymometer with its copper bar parallel to the lower portion of the aerial wire and a few inches from it, then set the transmitter coil in action and move the handle of the cymometer until the vacuum tube glows most brightly. The reading on the scale will give the wave length both in feet and metres. It will in general be found that there are two positions of the handle in which the tube glows. These correspond to the two wave lengths sent out from the aerial.

In making this experiment, and in fact in all cases in which the cymometer is used, as above described, the copper bar L_2, L_3, should be placed as far from the circuit being tested as possible. If it is placed too far away however, the vacuum tube will not glow under any circumstances, but if it is just brought near enough, a position will be found with a very sharp scale reading, in which the vacuum tube just glows.

In the previous courses of lectures I have explained the mode in which the oscillations in such an antenna throw off electric waves of definite wave length. The relation between the wave length λ of the radiated wave measured in centimetres, and the frequency n is given by the formula—

$$3 \times 10^{10} = n\,\lambda$$

Hence, since the frequency itself is expressed by the formula—

$$n = \frac{5 \times 10^6}{\sqrt{CL}} = \frac{5 \times 10^6}{O}$$

where O is the oscillation constant $= \sqrt{CL}$. Accordingly we can determine the length of the radiated wave when we know the oscillation constant of the antenna. This can be at once determined by placing the cymometer near to it, and moving the handle of the cymometer so as to adjust its capacity and inductance until the Neon tube shines most brightly. When this is the case, the scale reading of the cymometer shows its oscillation constant and therefore also that of the antenna. The wave length of the radiated wave is therefore given by the following formulæ—

$$\lambda = \frac{3 \times 10^{10}}{n}$$

$$n = \frac{5 \times 10^6}{O}$$

$$\therefore \lambda = \frac{3}{5}\, 10^4\, O$$

$$\text{or} \quad \lambda = 6{,}000 \times O \text{ cms.}$$
$$= 60 \times O \text{ metres}$$
$$= 200 \times O \text{ feet}$$

Accordingly the cymometer enables us to measure the wave length of the radiated wave and hence its name, from the Greek word κυμα = a wave.

In those cases in which we are using an antenna coupled to a closed syntonic circuit, waves of two wave lengths will be thrown off from the antenna in accordance with the principles just explained. These waves have wave lengths given by the formula—

$$\lambda_1 = \lambda_0 \sqrt{1 + k}$$

$$\lambda_2 = \lambda_0 \sqrt{1 - k}$$

where $$\lambda_0 = \frac{3 \times 10^{10}}{n_0}$$

n_0 being the natural frequency of the antenna taken alone.

In such a case the cymometer shows us not only that there are waves of two wave lengths thrown off from the antenna, but that these waves are of unequal insensity and damping. The wave which has the greatest wave length has the least damping and the greatest energy. The wave lengths of these two waves are connected with the natural wave length of the antenna taken alone by the formula—

$$\lambda_1^2 + \lambda_2^2 = 2\lambda_0^2$$

and the coefficient of coupling of the oscillation transformer can be shown to be given by the formula*—

$$k = \frac{\lambda_2^2 - \lambda_1^2}{\lambda_2^2 + \lambda_1^2}$$

For certain reasons it can be shown that the best results are obtained in the case of inductively coupled antennæ when the coupling coefficient, k, has such a value that one of these radiated waves has three times the wave length of the other.

* For the proof of this and other formulæ given in this lecture the reader is referred to the author's treatise on "The Principles of Electric Wave Telegraphy" (Longmans and Co.), or to the German work, Dr. J. Zenneck, "Elektromagnetische Schwingungen and Drahtlose Telegraphie."

The damping of the two radiated waves of different wave lengths is as already observed, different, but the decrements of the two waves are related to the decrements of the primary and secondary circuits when taken separately, and this relation has been determined by a formula, due to Drude. If δ_1 is the decrement of the primary or condenser circuit with the spark gap when taken alone, and if δ_2 is that of the antenna taken alone, then Drude had established the following relations :—

$$D_1 = \frac{\delta_1 + \delta_2}{2} \frac{n_1}{n_0}$$

$$D_2 = \frac{\delta_1 + \delta_2}{2} \frac{n_2}{n_0}$$

Where D_1 and D_2 are the decrements of the two waves of wave length, λ_1 and λ_2 thrown off by the antenna.

We see from the above formula that if we make k nearly unity or employ a very strong coupling, we can make one of the waves radiated from the antenna have much less damping than would be the case for a plain antenna alone. This establishes the importance of the inductive coupling of an antenna with a condenser circuit.

We can make use of the cymometer in a very large number of investigations in connection with high frequency currents. In fact, it is to high frequency currents what the direct reading potentiometer is to low frequency currents, a measuring instrument of wide application. For instance, we can use it to show that high frequency oscillations are confined entirely to the surface of conductors. If we construct two circular loops of wire, one of copper and one of iron of exactly the same size, then we find on attempting to measure the inductance of these loops with a cymometer as above described, that the iron loop damps out the oscillations and that it is difficult to obtain a reading with the iron wire. The cymometer has to be brought much closer to the primary circuit to cause the Neon tube to glow. If, however, we employ a galvanised iron wire of the same diameter and length as the same iron wire, or if we deposit electrochemically on the plain iron wire a thin coating of copper, we find that the inductance is the same as that of a copper wire and that the damping of the oscillations as shown by the behaviour of the Neon tube is the same as if the wire were zinc or copper.

We can also use the cymometer most advantageously to compare dielectric constants, or if we measure the capacity of a plate condenser formed of two thin plates of metal close together in air, and then insert a sheet of glass or ebonite between the two and measure the capacity again, the ratio of these capacities gives us the dielectric constant of the insulator. It is not difficult to show by experiments of this kind, that the dielectric constant of glass becomes reduced if the frequency is increased.

A simple formula for the capacity of an air condenser formed by two parallel plates is as follows :—Capacity in microfarads = area of plate in square centimetres divided by thickness of air space in centimetres multiplied by 11060000.

I have found this formula useful in connection with experiments on high frequency circuits.

THE POOR LAW, 1834-1905.

The reprint of the Poor Law Commissioner's Report of 1834 will be much appreciated by many interested in Poor Law questions, and who have not had the opportunity of studying the report in its older forms. It was one of these reports which made history. Like the Report of the Devon Commission, which sat a dozen years later, to inquire into Irish affairs, it disclosed a state of things which shocked the public conscience, and led to drastic legislation. At the time of the appointment of the Commission in 1832, the poor-rate amounted to 9s. 9d. per head of the population, and fourteen years earlier it had reached 13s. 4d., but the decline in the prices of the necessaries of life—in 1818, the price of wheat per quarter was 84s. 1d., in 1832 it had fallen to 63s. 4d.—was more than equivalent to the difference. The Commission was directed "to make diligent and full inquiry into the practical operation of the laws for the relief of the poor in England and Wales, and into the manner in which those laws were administered, and to report their opinion as to what beneficial alterations could be made." The result of the inquiry was laid before Parliameut two years later, in 1834. The Commissioners reported "fully on the great abuse of the legislative provision for the poor as directed to be employed by the Statute of Elizabeth," finding "that the great source of abuse was the outdoor relief afforded to the able-bodied on their own account, or on that of their families, given either in kind or in money." They also reported that "great maladministration existed in the workhouses." To remedy these evils, they proposed considerable alterations in the law, and the principal portion of their suggestions was embodied in the Poor Law Amendment Act, 1834.

The state of the country, as described by the evidence taken by the Commission, was appalling. The Commissioners found that the evils consequent on the then existing system of administering relief, both indoor and out-door, was "on the whole,

steadily and rapidly progressive." The effects on the owners of property were then stated, including the case of Cholesbury, in Buckinghamshire, where, in 1832, it was said the collection of poor-rate had "suddenly ceased, in consequence of the impossibility to continue its collection, the landlords having given up their rents, the farmers their tenancies, and the clergyman his glebe and his tithes." It is remarked, however, that the "evidence exhibits no other instance of the abandonment of a parish, but it contains many in which the pressure of the poor-rate has reduced the rent to half, or less than half what it would have been if the land had been situated in an unpauperised district, and some in which it had been impossible for the landlord to find a tenant." As to the magistrates, the Commissioners found that they had "exercised the powers delegated to them by the Poor Laws, not wisely indeed or beneficially, but still with benevolent and honest intentions, and the mischief which they have done was not the result of self-interest, or partiality, or timidity, or negligence, but was in part the necessary consequence of their social position, and of the jurisdiction which was confided to them, and in part arose from the errors respecting the nature of pauperism and relief which prevailed among all classes at the time when the allowance system and the scale were first introduced." The Commissioners go on to say that, "under the influence of such opinions even good intentions may become mischievous," and that "a more dangerous instrument cannot be conceived than a public officer, supported and impelled by benevolent sympathies, armed with power from which there is no appeal, and misapprehending the consequences of its exercise." Then the Commissioners advert to bastardy, "a branch of the Poor Laws distinguished from the rest both as to the principles on which it is founded, and the evils which it has produced. The several Acts on the subject had had for their objects the diminution of crime, and the indemnity of the parish; but whilst the first is the most important, the chief efforts were said to have been directed to the second, and with the usual fate of pauper legislation, for the indemnity of the parish was not effected, although every other object had been sacrificed to it. "The guidance of nature has been neglected; the task of resistance has been thrown on the man instead of the woman; marriages in which the least fault is improvidence have been not only promoted but compelled; every possible inducement has been held out to forging and falsifying, simply to save parishes from expense, and the effect has been in all probability to double or quadruple that expense, the indirect effect to augment it still more." Finally, the Commissioners declare that "even among the laws which we have had to examine, those which respect bastardy appear to be pre-eminently unwise."

Passing to the mode of administering relief, the Commissioners held that "in proportion as the condition of any pauper class is elevated above the condition of independent labourers, the condition of the independent class is depressed, their industry is impaired, their employment becomes unsteady, and its remuneration in wages is diminished. The converse is the effect when the pauper class is placed in its proper condition below the position of the independent labourer;" and, therefore, "every penny bestowed that tends to render the condition of the pauper more eligible than that of the independent labourer" is declared to be "a bounty on indolence and vice." The Commissioners therefore recommended that "all relief whatever to able-bodied persons, or to their families, otherwise than in well-regulated workhouses (*i.e.*, places where they may be set to work according to the spirit and intention of 43rd Elizabeth), shall be declared unlawful, and shall cease, in manner and at periods hereafter specified, and that all relief afforded in respect of children under the age of 16, shall be considered as afforded to their parents." The chief evil of the then existing practice being the prevalence of pauperism among the able-bodied, and a well-arranged workhouse having, in the opinion of the Commissioners, proved a remedy for this evil, the means by which workhouses could best be provided, and proper management of them enforced, were next considered. The Commissioners give it as their opinion that the inmates of every workhouse should be separated into not less than four classes, namely (1) the aged and really impotent; (2) the children; (3) the able-bodied females; (4) the able-bodied males—of whom it was observed, "We trust that the two latter will be the least numerous classes." The Commissioners considered that emigration had been one of the most innocent palliatives of the evils of the system they were examining, and might be advantageously made available to facilitate the application of the remedies they suggested. They recommended, "That the Vestry of each parish be empowered to order the payment out of the rates raised for the relief of the poor of the expenses of the emigration of any persons having settlements within such parish, who may be willing to emigrate; provided that the expenses of such emigration be raised and paid within a period to be mentioned in the Act."

In concluding their report, the Commissioners said, "We have now recommended measures by which we hope that the enormous evils resulting from the present maladministration of the Poor Laws may be gradually remedied." But they add, "We are perfectly aware that for the general diffusion of right principles and habits we are to look not so much to any economic arrangements and regulations, as to the influence of a moral and religious education," and they further add, that "one great advantage of any measure which shall remove or diminish the evils of the present system is, that it will in the same degree remove the obstacles which now impede the progress of instruction, and intercept its results; and will afford a freer scope to the operation of every instrument which may be employed for elevating the intellectual and moral condition of the poorer classes." The Poor Law

Amendment Act of 1834 was the outcome of the report.

Sixty years have passed since then. Relatively to the wealth and population of the country, pauperism has never since the passing of that Act been an overwhelming burden. But there was always opposition to the strict theory which underlies the Act, and this dissent has grown in recent years, when legislative effort has been directed rather to secure the comfort than the emancipation of the pauper. The cost of the relief of the poor is not very much less now than when the Commission of 1832 was appointed. In that year the population of England and Wales was 14,105,600, and £7,036,969, or at the rate of 10s. per head on the population, was expended for the relief and maintenance of the poor. After that, and for a time, the rate of expenditure fell so rapidly that in 1837 it was only 5s. 5d. per head of the population, and in 1853 only a penny more. In 1880 it had increased to 6s. 3¾d., and last year it was 8s. 0¼d. It must be remembered, too, that in 1832 the cost of necessaries was very much greater than now. For example, wheat was at 63s. 4d. per quarter whereas in 1904 the average was only 27s. 4d. Among the scandals most effectively dealt with by the Commission, and subsequent legislation, was bastardy. The old law was a premium on immorality. To the mother of a legitimate child in distress the weekly allowance in many places was 2s., whereas the mother of an illegitimate child was paid from 2s. to 3s. per week, according to the circumstances of the father, and the maintenance was paid to the mother whether received from the father or not. In this way the offence was encouraged by placing such women in a better situation than many married women, with the result that bastardy was rife throughout the land. The contrast to the present state of things in this respect is very striking. In 1870 2, the proportion of illegitimate births had fallen to 17·0; for the three years ended 1903 it was only 8·4.

THE MANUFACTURE OF INLAID BRASSWORK AT CAIRO.*

There is a considerable demand at Cairo each year for brasswares of various kinds, in the form of utensils and ornamental objects. Amongst these wares the richest in effect, and that requiring the most skill for its perfection, is inlaid with silver or gold. The greater part of the pieces of this for sale in the Cairo Bazaar are, however, made in Damascus, where labour is considerably cheaper than in Cairo, and where many more workmen are engaged in the production. While in Cairo, it is said, there are only about thirty men skilled in inlaying, in Damascus there are several hundred; on the other hand, the quality of the Damascus work is said to be inferior to that of the best Cairene.

* Communicated by W. L. Hildburgh.

Although the art of incrusting metal on metal is of considerable antiquity amongst the Arabic nations, the ancient specimens of incrusted work are to-day, in Egypt at least, quite rare. In appearance the applied metal consists of thin sheets in the form of lines, geometrical figures, scrolls, diapers, Arabic inscriptions, conventionalised birds and animals, and broad areas, which, for the most part, are slightly raised above the body and are burnished; in some objects they are also engraved. The whole of this decoration is, however, applied in the form of wire, which is afterwards flattened by hammering.

The metal for the body is usually brass, upon which may be silver, less frequently copper, or silver gilt, and rarely, on account of its cost, gold; generally the copper and gold are used only in conjunction with silver, to enhance its effect. The objects decorated are mainly ewers, jugs, trays, coffee-pots and cup-holders, hanging lamps, boxes, and the like. Some of the pieces are of considerable size, elaborately covered trays, 24 to 28 inches in diameter being occasionally to be found.

Both rolled and cast brass are used for the bodies to be inlaid. The cast metal is employed for small pieces, such as coffee-cup-holders, when it is desirable that each should be of a single piece, and solid, though it is more difficult to work than, and does not hold the silver so well as, the wrought metal. The bodies are imported from Europe ready-shaped, or are made in the Bazaar; the former are spun or cast, while the latter are bent, hammered, and soldered, or are drawn seamless by hammering. An idea of the methods employed is best to be obtained by following a special piece, such as one of the small Arab coffee-pots, from the smooth sheet to completion.

The coppersmith, having received the specifications of the object, furnishes the body, spout, cover, and bottom separately to the manufacturer. Each piece is then filled with a melted bituminous compound, which hardens to a tough solid, and passes to the engraver, who, working without patterns or preliminary sketches, draws the design directly upon the brass with a writing brush and ink. Having chiselled it, he delivers the pieces, now decorated in the manner of the greater part of the brassware sold.

Next the pieces go to the inlayer, upon whose skill the beauty of the finished object will mainly depend, and whose tools are a light hammer and three chisels. The head of the hammer is square at its shorter end, and tapers to an oblong at its longer, the square end being used to strike the chisels, and the oblong to fix the wire in position. One of the chisels tapers gradually to a point, and is used for the correction of faults in the engraving; the second is a long narrow wedge, with its edge brought to a point by grinding back at an angle from one corner, and is used to cut the holes by which the wire is held; and the third is a very narrow wedge for severing the wire at the end of each line.

The inlaying is done in small sections, the workman going over one of these with his second chisel, cutting a line of very closely placed holes, each of which has a sharp little point of forced-out metal at one side; by means of these little points the wire is caught and held. The wire is placed at the beginning of a line, and is carried along it, being forced into position by sharp taps of the hammer, and at the end of the line is cut by the third chisel. For broad surfaces the lines are made parallel and adjacent, and when the wires have been laid sufficiently close and the work properly finished, it is often impossible to see the edges of juncture, the whole presenting the appearance of a solid sheet. When well laid the wire, which is of a very soft, pure silver, will break when pulled, rather than leave the brass.

A good workman will generally lay from 24 to 32 inches of wire per day of ten hours, depending on the care he exercises, and the quality of his work, and will receive from six piastres (one piastre = $2\frac{1}{2}$d.) to twelve piastres per day, according to his skill. These wages are high, some brass decorators (those who fill in backgrounds, or do similar work) receiving as little as two piastres per day.

The inlaying having been completed, the workman burnishes it with the broad end of his hammer, finishing with a curved steel rod of circular section. The pieces are then returned to the engraver, who decorates such of the silver surfaces as require further ornamentation, and also, for the best quality of work, carefully chisels the outlines of the inlaying where they appear rough. The decoration finished, the bituminous filling is removed by striking the pieces with a small wooden mallet, and by scraping off the small quantity of it which remains adherent.

The pieces are then returned to the coppersmith, who tins the interiors, punches holes for the exit of the coffee, and attaches, by soft solder, the bottom, spout, and handle, and the hinge and knob of the cover. Finally, after cleaning, the exterior is rubbed with black, to bring out the details of the engraving. Such, with minor modifications dependent on the shape and quality of the objects, are the steps followed in the making of all inlaid work of this character.

The faults to be found in objects so decorated are as follows:—The wire s missing from parts of the prepared surface, or is loose, due to imperfect preparation, this being especially liable to occur with cast brass bodies. The cutting off of the wire is carelessly done, giving a stepped appearance to the outlines of a broad surface. The holes are too deep for the size of wire used, so that the silver lines have wavy edges. The parallel lines of holes for a broad surface are too far apart for the wire used, cracks showing over the silver surface, or even irregular lines of brass being visible. Occasionally, when the brass has proven bad locally the parts which have refused the wire are tinned, giving them a dull, flat, leaden appearance, observable at a considerable distance.

GLEANINGS FROM THE UNITED STATES RAILWAY RETURNS.

The Personnel, its Allocation and Remuneration. —For the working of the railway systems of the United States a total number of 1,312,537 persons are required, or an average of 639 *employés* per 100 miles of line. Of the gross total 4,842 are returned as "general officers," and these receive an average daily remuneration of 11·27 dollars apiece. Other officers, numbering 5,039, received 5·76 dollars per diem. General office clerks, numbering 42,818 persons, received an average remuneration of 2·21 dollars, or less than was paid to each of 56,041 firemen (who had 2·28 dollars daily), or less than was paid to each of 52,993 engine men (who had 4·01 dollars daily). Telegraph operators numbered 30,984, these receiving 2·08 dollars per day. The most numerous class are trackmen, a class of *employés* which in England would be allocated to the maintenance of the permanent way. These number 300,714 and receive as payment the sum of 1·31 dollars per diem. Reckoning the staff under four main headings the following are the chief grades and the number per 100 miles of line:—General administration 22, maintenance of way and structures 211, maintenance of equipment 124, conducting transportation 281, and unclassified 1.

Railway Capital.—The total capital invested in the railway systems of the United States is practically 12,600,000,000 dollars, or upwards of 63,186 dollars per mile of line. This large total is made up of 4,877,000,000 dollars of common stock, 1,278,600,000 dollars of preferred stock, and a total funded debt of bonds, equipment trust obligations, &c., of over 6,444,000,000 dollars.

Dividends Paid.—Only an aggregate of 56 per cent. of the ordinary and preference stock paid any dividends at all to the shareholders. On the common stock 152,218,000 dollars was paid, and on the preferred stock 44,480,000 dollars. The total par value of these two stocks which were dividend paying amounted to 3,450,738,000 dollars, the average rate of interest thus working out at 5·70 per cent. The sums paid as interest on the funded debt amounted to 283,953,000 dollars, or an average return of 4·4 per cent.

Extent of the Passenger Traffic.—This item of course, for a country with a population of about 80,000,000 inhabitants runs into very large figures, the total number of passengers carried being 694,891,535, while the passenger mileage (*i.e.*, the equivalent number of passengers carried one mile) was 20,915,763,881. The passenger train mileage aggregated 425,142,204 miles, while the average number of passengers in a train was 46, and the average journey per passenger being 30·10 miles. The revenue per passenger per mile was 2·006 cents.—a figure probably in excess of the average revenue from the same service in England. Each passenger train secured a revenue of 1 dollar 11·644 cents, the mean cost of running the average trains, goods and passengers, was 1 dollar 26·604 cents. It should not be imagined, how-

ever, by railway shareholders that these figures imply a loss actual or virtual on the passenger traffic. The apparent loss is merely due to a defective system of account keeping which does not, and indeed cannot, provide for an allocation of the proportion of working expenses due to each type of traffic.

Extent of the Freight Traffic.—Even if the Interstate Commerce Commission dealt with the lake, coasting, and river traffic, which it does not, it would be manifest the great bulk of the movements of merchandise would be rail-borne. The tonnage carried by the railways amounted to 1,304,394,323 tons, while the ton-mileage reached the stupendous value of 173,221,278,993 tons. Compared with the passenger trafic, for each passenger carried for one mile, nearly $8\frac{1}{2}$ tons of freight were conveyed a similar distance. The freight train mileage was 526,312,433, and the freight car mileage amounted to 14,193,718,005, or practically 27 cars per freight train. The average tonnage of paying weight per train was 310·54 tons, while the average distance that each ton was hauled, all the railways being regarded as a single system, was 242·35 miles.

Produce Carried.—The tonnage of agricultural products, "reported as originating on road," or, in other words, enumerated at original stations of consignment, independent of the number of systems traversed, amounted to 61,056,212 tons. Half of this, or 30,188,316 tons, consisted of grain, while flour weighing 7,276,908 tons was carried. Raw cotton weighed 3,175,117 tons, and fruit and vegetables weighed 7,127,190 tons. The products of animals "originating on road" amounted to 16,802,893 tons, of which 9,803,871 tons were live stock, the balance comprising dressed meat, packing-house products, poultry, game, fish, wool, hides, leather, &c. The products of mines totalled 392,335,261 tons, of which 170,203,832 tons were of bituminous coal, 40,351,603 tons of anthracite, 26,126,220 tons of coke, 46,692,362 tons of ores, and 41,523,163 tons of sand. Products of forests "originating on road," amounted to 74,559,980 tons, of which 51,075,510 tons were lumber. Manufactured goods contributed a gross tonnage of 91,980,903, the most important articles in point of bulk being pig and bloom iron, 16,604,066 tons; cement (brick and lime), 20,247,502 tons; bar and sheet metal, 11,721,664 tons; iron and steel castings and machinery, 11,133,353 tons; and iron and steel rails, 5,124,681 tons.

Loaded and Empty Freight Car Mileages.—As already stated, the total freight car mileage amounted to 14,193,718,005. A very striking return shows that of this amount, 9,844,158,056 represents the mileage of loaded freight cars, and 4,346,790,165, the mileage of empty freight cars. On the best regulated railways in the world it is impossible for the goods waggons to have no empty or idle mileage. The ratio which the available capacity hauled actually bears to the freight hauled very rarely exceeds fifty per cent. when allowance is made for waggons only partially filled. In the United States, while one-third of the freight car mileage produces no direct revenue whatsoever, the balance, through waggons being partially empty, cannot conceivably be revenue-earning to its full capacity. More direct information on this matter, on the lines familiar to students of the Indian Government Railway Returns, would be of interest and not wholly devoid of value.

THE JAPANESE COTTON INDUSTRY.

Few fields present so many interesting phases of industrial and commercial life as are to be found in Japan. In many ways, seemingly heavily handicapped, the Japanese have succeeded in securing a success, not only in war, but in manufacturing and marketing goods, almost as phenomenal as that won by their arms in Manchuria. According to the American Consul at Yokohama, Japan has had an unprecedented success in her cotton mills; they have increased rapidly, paid large dividends, and promise great things in the future. The demand for cotton yarn largely increased during the first six months of 1905, owing to the requirements of the army, but the activity of the export trade is also responsible in no small degree for the extraordinary prosperity of the industry. The profits of the spinning companies have been augmented all the more on account of the fact that, despite the good prices realised for the yarn exported, the cost of raw cotton has remained lower than usual. The highest dividend declared for the half-year is by the Settsu Cotton Spinning Company, at the rate of 36 per cent. The Miye, Kishiwada, Wakayama, Amagasaki and Kurashiki Companies have all shown dividends amounting to more than 30 per cent. All the other spinners have also declared dividends from 10 to 20 per cent. The average rate of dividend on the total paid-up capital of all the cotton-spinning companies in Japan during the first half of 1905, correspond to 17 per cent., which, as compared with 6·6 per cent. for the first half and 8·5 per cent. for the second half of 1904, is more than double. At the end of June last the number of cotton-spinning companies throughout the country was 37, with an aggregate paid-up capital amounting to about £3,300,000. The total consumption of raw cotton during the period under review aggregated 206 million pounds, of which 100 million was Indian cotton, 66 million American, and 33 million Chinese. The total quantity of yarn manufactured during the half year amounted to 453,701 bales of 400 pounds each. Out of this, 314,955 bales were taken for home consumption, while 138,746 bales were exported. Altogether the spinning industry in Japan enjoyed extraordinary prosperity during the period ended June last, and it is stated that there is every indication of this prosperity continuing.

HOME INDUSTRIES.

The Brewing Industry.—Reference was made in this column last week to the depreciation of brewery securities, and the unsatisfactory condition of the brewing interest. The default of another large Burton firm in regard to debenture interest emphasises what was said as to the position of the industry. The diminution of consumption, and the increase of State and municipal taxation, have been among the contributory causes, but there can be little doubt that reckless competition for "tied" public houses has had most to do with the losses investors have now to face. A correspondent writing in the financial supplement of *The Times* points out that the change from the free to the tied trade has, so far as Burton is concerned, not only led to heavy financial losses, it has changed and deteriorated the quality of the ales produced. "Brewers having obtained at high prices a virtual monopoly so far as their own properties are concerned, have been compelled to reduce the prime cost of their productions to a level which would have been incredible to the Burton of a generation ago, and this reduction has meant, in many cases, a diminution in the quality and intrinsic value of the products offered to the public." It is a significant fact that there are only two Burton brewery companies whose ordinary securities stand above par on the London Stock Exchange. Fortunately for the brewers trade is improving, and, though they are the last to feel the benefit, increased consumption of beer follows all such revivals, whilst the low price of hops, and the method of cold storage, which enables them to be stored for long periods without injury, points in the same direction, and warrants the expectation that better times are in front of breweries not hopelessly overcapitalised, and prudently managed.

Rating Mot r-Cars.—Municipal authorities, uneasy as to the effect of the competition of motor omnibuses upon their costly tramway enterprises, are beginning to move in the direction of rating motor omnibuses, and limiting their routes by legislation. Obviously tramway enterprise is heavily handicapped by the immense expenditure required on the roads over which they run, but it is not likely that this disadvantage would be neutralised by any additional rating, or limitation of routes, that Parliament could be induced to sanction. The motor omnibuses bid fair to take away an appreciable portion of the passengers who have been attracted to the electric tramways. It is true that the horse omnibus will soon have disappeared, thus supplying a large constituency for its motor successor to work upon, but the motor omnibus will soon be on all routes to the serious loss of the tramways. The working expenses of the motor omnibus companies must of necessity be much lower than those of the electric tramways, with the result that they will be able to carry passengers more cheaply. It is doubtful whether even now the electric tramways in London and elsewhere pay their way. At best the margin of profit is very small, and it is difficult to see how there can be any when the motor omnibus competition has developed to its full extent. The outlook for municipalities which have mortgaged the municipal resources heavily for the purpose of providing electric tramways is somewhat disturbing, and it is a little surprising that the Royal Commission, recently inquiring into the traffic question, did not more clearly forsee the formidable character of motor omnibus competition.

Canal Developments. — As bearing upon the remarks on this subject in the *Journal* of December 29th last, reference may be made to reports just issued (Cd. 2760) from His Majesty's representatives on Navigable Inland Waterways in Austria-Hungary, Belgium, France, Germany, and the Netherlands. These reports show that, with the exception of the first named, in all these countries large sums are being spent in the improvement and extension of the canals. In Austria-Hungary, the canal construction prescribed by the law of the 11th June, 1901, has been delayed largely because of the technical difficulty connected with the system of "lifts," which it is proposed should be employed on the canals in lieu of "locks." A trial lift is now to be constructed at Anjezd, near Prevan, in connection with the Danube-Oder Canal, and will be tested prior to the actual commencement of the canal construction. In France, the Government was authorised by a Law of the 23rd December, 1903, to carry out canal improvements and new works at an estimated expenditure of £8,240,000, of which £1,160,000 is to be appropriated to completing works of improvement already begun on waterways, and £7,076,000 is to be devoted to new works. In the case of the Canal du Nord, the Chamber of Commerce at Douai will contribute half, viz., £1,200,000, of the estimated expenditure. The Chamber of Commerce of Marseilles, the Department of the Bouches du Rhone, and the city of Marseilles will provide a subsidy of £1,420,000 for the construction of the canal from Marseilles to the Rhone. This is half the estimated expenditure, and will be reimbursed by receipts from tolls. Similar arrangements have been made between the Government and the Chamber of Commerce of Cette and the Municipal Councils interested as regards the canal from Cette to the Rhone. Under the Law of the 1st of April, 1905, expenditure is authorised for new canals in Prussia to the extent of £16,728,750, of which £12,537,500 fall to the cost of making the canal from the Rhine to the Weser, including the canalisation of the Lippe and various accessory works. In the Netherlands the new channel from Hevsden and Keizersveer, on the Oude Maas, discharging *viâ* the canalised Amer into the Hollandsch Diep has been completed at a cost o £1,750,000, the North Sea Canal has been brought up to date so as to enable it to admit to the port of Amsterdam vessels of the largest modern construction, and the work of enlarging the accommodation of the Ter Neuzen-Ghent Canal, so as to enable it to carry vessels of 28 feet draught and corresponding tonnage,

is being vigorously carried out at a cost estimated at about £943,750, the whole of which will be borne by Belgium.

Electric Traction for Canals.—It has been suggested that electric traction might assist our canal traffic but the difficulties in the way are great. On the Continent the experiment has been made of substituting a trolly "tractor" for the horse with encouraging results, but this could not be made profitable on English canals unless and until traffic becomes much denser than it is at present, or well can be under existing conditions. The case of the tramways is not analogous. The electric tramway bids fair to be a commercial success because it covers a much larger mileage than the horse tramway and attracts a large number of passengers who could not be got into the slower conveyance. Of course, it is desirable that there should be quicker carriage on the canals, but without a much larger traffic cost stands in the way. Perhaps a beginning will be made with petrol tugs, and, if this improved means of haulage leads to more traffic there may be resort to electric tractors. But much will have to be done in many ways before our inland waterways approach those of the Continent in activity and usefulness.

By-laws and Building.—The Local Government Board have addressed a letter to Rural District Councils which, it may be hoped, will have some effect in bringing building by-laws in rural districts more into line with commonsense. As the Board point out, the adoption of the urban model series in rural districts has led to interference with reasonable building operations, and the Board feel that "a series of by-laws so extensive as the urban model is not necessary for a district, or part of a district, where little building is going on, and aggregations of population are not likely to develop in the near future. In such cases it is considered that a less elaborate code of building regulations would generally be found sufficient." The Board are desirous that no obstacle should exist which can properly be avoided in the way of an extension of housing accommodation, whether by local authorities or private persons, and the object of the circular is "to secure that, whilst sanitary requirements should be strictly observed, all unnecessary impediments in the development of building should be avoided." The Board therefore suggest that Rural District Councils should "carefully review the circumstances of their district for the purpose of seeing whether any modification of the present by-laws is desirable, and whether any part of the district might more suitably be placed under a series based on the rural model, or, if this is not thought suitable, by such a series supplemented by a limited selection of clauses from the urban model." The latter can hardly fail to effect some good but, unfortunately, District Councils are not always influenced solely in dealing with building questions, by considerations of the public interest.

The Rubber Industry.—The rubber industry continues to expand rapidly, and many new companies for dealing with rubber are known to be in course of formation, whilst the Stock Exchange is talking about a separate market for dealings in rubber shares. The imports of rubber last year were exceptionally large, and throughout 1905 the price was better than in the preceding year. It is thought likely that the present year may see a considerable further advance in prices, but it may be expected that before very long the supply will be ample for all demands. Not only are there immense tracts of rubber which remain untouched in Liberia and elsewhere, the cultivation of the rubber tree is being rapidly extended. Java, for example, is planting extensively, and within the next six or eight years the exports from that island are likely to be very large. In Ceylon, too, and the Malay Peninsula considerable tracts of country are being planted with rubber. The way in which the tree adapts itself to the various climatic conditions obtaining in different countries is almost unique in tropical cultivation. It grows rapidly under cultivation.

Small Holdings.—Mr. Rider Haggard has addressed an interesting lettter to *The Times* (January 6) on the decrease in the rural population, and the best way of checking it and inducing a return to the land. Dealing with the objection that town folk are of no use upon the land, he insists that "many of those who come from the land could be moved back to the land, or, in any case, their children could." Perhaps more might be done with the children if they were properly trained, and few will be found to dispute Mr. Haggard's contention that "no nation can endure which permanently abandons the land life for that of cities." But there are many difficulties in the way of successful home colonisation, and it is necessary to face them. Those who are to make a living out of the land must know something about the land; they must be acquainted with the requirements of modern markets; they must know how to gather, and pack, and place; the land must be suitable - five acres of cold clay will not give a man a living; transport to a market must be quick and cheap; rent and rates must be moderate. But even when all these conditions are fulfilled—and they are not easy to fulfil—the question of price remains. Imports have so reduced the price of agricultural products that the average small holder can market, that at best profits must be very small. It is obvious that only shrewd, energetic, capable and thrifty men, with knowledge of the soil, can hope to succeed, and these are qualities not usually found in persons who have drifted to the towns and cannot make a living there.

CORRESPONDENCE.

OLD SILVER PLATE.

I should like to call attention to the article on "Old Silver Plate" in the last number of the Society's *Journal*. I must demur to the author's remark that it was "a very common thing for specimens to bear both marks, and some of these are now in existence." I have seen as much old plate as anybody, but have never yet seen a specimen bearing the marks of both standards. The sovereign's head introduced in 1784 had no connection whatever with the standard mark, as the author maintains, but was used to denote that the duty had been paid. This mark of a "sovereign's head" lasted till 1890. The lion passant was introduced in 1544. I myself once possessed the first specimen ever found with the mark of this year, and I wrote to the late Mr. Cripps thereon shortly before his death. Since then I have come across other specimens bearing the Hall-mark of 1544, with the lion passant. I am sure a better article could have been written if "Jackson" had been quoted instead of "Cripps." LIONEL A. CRICHTON.

22, Old Bond-street, London, W.,
January 8th, 1906.

GENERAL NOTES.

CARNEGIE RESEARCH SCHOLARSHIP.—A Research Scholarship or Scholarships, of such value as may appear expedient to the Council of the Iron and Steel Institute from time to time, was founded by Mr. Andrew Carnegie (Past-President), who has presented to the Iron and Steel Institute eighty-nine one-thousand dollar 5 per cent. Debenture Bonds for the purpose. This will be awarded annually, irrespective of sex or nationality, on the recommendation of the Council of the Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the Secretary of the Institute. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school or works, provided it be properly equipped for the prosecution of metallurgical investigations. The appointment to a Scholarship shall be for one year, but the Council may at their discretion renew the Scholarship for a further period instead of proceeding to a new election. The results of the research shall be communicated to the Iron and Steel Institute in the form of a paper to be submitted to the annual general meeting of members, and if the Council consider the paper to be of sufficient merit the Andrew Carnegie gold medal shall be awarded to its author. Should the paper in any year not be of sufficient merit the medal will not be awarded in that year.

GERMAN PAPER PRODUCTS.—Sixty years ago a Saxon weaver discovered the process of utilising soft wood for making paper, but it was not until about 1870 that the discovery of a new chemical process, namely, the application of caustic soda, rendered it possible to obtain a pure cellular tissue for the manufacture of paper. In 1871, the first paper mill worked upon this new method was set up in Germany, and in course of a short time many others were established. A few years later, the use of sulphurous acid was found to be not only simple, but cheaper than soda, and the "sulphide method" has since been generally employed. Next to the United States, Germany is now the most important paper-producing country in the world. The total paper and pasteboard production of the world, during the past year, is estimated at 7,000,000 cwts., of which 31·50 per cent. was ordinary printing paper. "The great and rapid development of the German paper industry," writes Sir W. Ward in his report, just published (No. 642, Miscellaneous Series) "has not only in itself become a very important factor in the economic life of Germany, but the large present consumption of wood for paper and pasteboard making has become a matter of considerable importance for German forest culture, notwithstanding that the importation into Germany of wood-pulp for paper manufacture is extensive." The paper and pasteboard imported by the United Kingdom last year from Germany, are stated by a German commercial journal, quoted by Sir W. Ward—the German official statistics are not yet available—to have been £1,531,400.

COTTON IN THE LEEWARD ISLANDS. — The report of the Acting Governor of the Leeward Islands for the year 1904-5 (Cd. 2684) contains a reference to the cotton industry which shows it is making fair headway in the islands. In 1903-4 cotton was grown in a tentative manner over a considerable area, while in St. Kitts and Montserrat the cultivation was carried on on a somewhat large scale. The results were variable, but such as to lead to a considerable extension of the industry, so that in the latter part of 1904 it was estimated that the following acreage was under cultivation in Sea Island cotton: — Antigua and Barbuda, 500 acres; St. Kitts, 1,000 acres; Nevis, 1,050 acres; Arguilla, 300 acres; Montserrat, 500 acres. Future developments will largely depend upon the prices realised. The Acting Governor says that the Imperial Department of Agriculture has been at great pains to afford assistance in every branch of the industry, promising seeds, assisting to combat pests and diseases, affording information and advice at every stage.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

JANUARY 17.—"The Scientific Aspects of Voice Development." By WILLIAM A. AIKIN, M.D.

JANUARY 24.—"The Planting of Waste Lands for Profit." By DR. J. NISBET. H. W. ELWES, F.R.S., will preside.

JANUARY 31—"The Garden City and the Cheap Cottage." By THOMAS ADAMS.

FEBRUARY 7.—"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E. SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

FEBRUARY 14.—"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON. COLONEL H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 21.—"The Fisheries of the North Sea." By WALTER GARSTANG, M.A. EDWIN RAY LANKESTER, M.A., LL.D., F.R.S., will preside.

FEBRUARY 28.—"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.). SIR JOHN WOLFE-BARRY, K.C.B., LL.D., F.R.S., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

JANUARY 18.—"The City of Calcutta." By CHARLES EDWARD BUCKLAND, C.I.E. SIR JAMES L. MACKAY, G.C.M.G., K.C.I.E., will preside.

FEBRUARY 15.—"The Navigable Waterways of India." By ROBERT BURTON BUCKLEY, C.S.I.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

FEBRUARY 6.—"Imperial Immigration." By OCTAVIUS CHARLES BEALE, President of the Federal Council of the Chambers of Manufactures of Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock :—

JANUARY 30.—"Chemistry of the Painter's Palette." By J. M. THOMSON, LL.D., F.R.S.

FEBRUARY 20.—"Illuminated Manuscripts." By H. YATES THOMPSON, F.S.A.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." Five Lectures.

LECTURE I.—JANUARY 29.—Characteristic features of warships—Materials of construction—Structural arrangements—Operations of building and launching.

LECTURE II.—FEBRUARY 5.—Armour protection—Systems of disposition—Methods of manufacturing armour plates—Recent improvements in quality, and consequent changes in designs of warships.

LECTURE III.—FEBRUARY 12.—Armaments—Progress in the design and manufacture of guns, mountings and machinery for working heavy guns—Improvements in projectiles and explosives.

LECTURES IV. AND V.—FEBRUARY 19 and 26.—Recent types of warships, British and Foreign—Battleships—Armoured and protected cruisers—Scouts—Torpedo boats and destroyers—Submarines.

HOWARD LECTURES.

Thursday evenings, at 8 o'clock :—

PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., "High Speed Electric Machinery, with special reference to Steam-Turbine Machines." (Three Lectures.)

LECTURE I.—JANUARY 18.—*The Problems of Electric Design as affected by Speed and rated Output.*—Economic generation of electric energy dependent on cost of prime power, on type of prime mover, and on design of electric generator—Slow-speed generators developed on Continent and in United States to suit slow-speed engines, or for coupling to water-turbines—High-speed engines developed in England to suit high-speed generators—More recently the use of motor generators and of steam-turbines has emphasized the development of new forms of generators suitable for very high speeds—Output of an electric generator dependent on iron, copper, speed, and insulation—Dependence of design on "factors of utilisation"—Conception of the "active belt"—Efficiency—Energy-losses in different parts—Ventilation—Regulation—Frequency—Commutation—Relation of surface-speed to design—Limits of design as to (1) strength of materials, (2) permissible temperature-rise, (3) sparkless commutation—Output rules—Examples of low-speed design—Examples of high-speed design.

LECTURE II.—JANUARY 25.—*Turbo-dynamos.*—The problem of commutation—Use of carbon brushes and of metal brushes—Natural and forced commutation—Peripheral speed in relation to commutation—Loading of armatures—Armature distortion—Limits of design as affected by permissible temperature-rise and by sparkless commutation under all loads—Problem of centrifugal forces as affecting dynamo design—Turbo-dynamo designs.

LECTURE III.—FEBRUARY 1.—*Turbo-alternators.*—Relation between frequency, number of poles, and revolutions per minute—Relation between frequency, surface-speed, and pole-pitch—Turbine speeds and field-magnet design—The limitations of magnet design—Balancing—Armature-design in alternators—Nature of armature reaction—Armature-design as affected by power-factor of the load—Mechanical considerations—Ventilation of turbo-alternators—Forced ventilation—Efficiency; overload possibilities; limits of design—Excitation of field-magnet system—Preference given to very low voltage of excitation—Examples of turbo-alternators.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 15...Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. A. T. Walmisley, "Modern Surveying Instruments."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. Dr. Alexander Irving, "Evolutionary Law in the Creation Story of Genesis."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. J. G. Broodbank, "Notes on the Port of London."

TUESDAY, JAN. 16...Royal Institution, Albemarle-street, W., 5 p.m. Prof. E. H. Parker, "Impressions of Travel in China and the Far East." (Lecture I.)

Civil Engineers, 25, Great George street, S.W., 8 p.m. Discussion on the following papers:—"The Elimination of Suspended Solids and Colloidal Matters from Sewage," by Mr. David Ernest Lloyd-Davies. "The Elimination of Suspended Solids and Colloidal Matters from Sewage," by Lieut.-Colonel Alfred Stowell Jones and Dr. William Owen Travis.

Statistical, in the Theatre of the United Service Institution, Whitehall, S.W., 5 p.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Sir Charles Eliot, "The Progress and Problems of the East Africa Protectorate."

WEDNESDAY, JAN. 17...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Dr. William A. Aikin, "The Scientific Aspects of Voice Development."

Meteorological, 25, Great George-street, S.W., 7½ p.m. Annual General Meeting. Presidential Address by Mr. Richard Bentley on "Meteorology in Daily Life."

Microscopical, 20, Hanover-square, W., 8 p.m. Presidential Address, "The Life and Work of Bernard Renault."

Entomological, 11, Chandos-street, W., 8 p.m. Annual Meeting.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, JAN. 18...SOCIETY OF ARTS, John-street, Adelphi, W.C. 4½ p.m. (Indian Section.) Mr. Charles Edward Buckland, "The City of Calcutta."

SOCIETY OF ARTS, 8 p.m. (Howard Lecture.) Professor Silvanus Thompson, "High Speed Electric Machinery, with special reference to Steam Turbine Machines." (Lecture I.)

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. A. W. Allen, "The Life History of Margaritifera Panasesa." 2. Mr. A. D. Cotton, "Some Endophytic Algæ." 3. Dr. R. Broom, "Jacobson's Organ of Sphenodon."

Chemical, Burlington-house, W., 8 p.m. 1. Messrs. H. A. Miers and F. Isaac, "The Refractive Indices of Crystallising Solutions with especial reference to the Passage from the Meta-Stable to the Labile Condition." 2 Messrs. A. D. Hall and A. Amos, "The Determination of available Plant Food in Soils by the Use of Weak Acid Solvents." Part II. 3. Messrs. O. Silberrad and G. Rotter, "The Action of Ammonia and Amines on Diazobenzene Picrate." 4. Messrs. O. Silberrad and B. J. Smart, "The Preparation of *p*-Bistriazobenzene." 5. Messrs. O. Silberrad and C. S. Roy, "Gradual Decomposition of Ethel Diazo-acetate." 6. Messrs. O. Silberrad and B. J Smart, "Studies on Nitrogen Iodide" Part III. "The Action of Methyl and Benzyl Iodides." 7. Mr. J. E. Reynolds, "Silicon Researches." Part X. "Silicon Thiocyanate." 8. Messrs A. W. Stewart and Mr. E. C. C. Baly, "The Relations between Absorption Spectra and Chemical Constitution." Part I. "The Chemical Reactivity of the Carbonyl Group." 9. Messrs. F. D. Chattaway and W. H. Lewis, "Halogen Derivatives of Substituted Oxamides." 10. Miss M. B. Thomas and Mr. H. O. Jones, "The Effect of Constitution on the Rotary Power of Optically Active Nitrogen Compounds." Part I. 11. Messrs. T. S. Patterson and J. Frew, "Menthyl Benzene Sulphonate and Menthl-β-Naphthalene Sulphonate." 12. Mr. R. S. Bowman, "An Apparatus for the Continuous Extraction of Liquids with Ether." 13. Messrs. J. T, Hewitt and N. Walker, "Action of Bromine on Benzeneazo-o-nitrophenol." 14. Mr. E. B. R. Prideaux, "Some Reactions and new Compounds of Fluorine." Part I. 15. Messrs. E. C. C. Baly and A. W. Stewart, "The Relation between Absorption Spectra and Chemical Reactivity." Part II. "The Quinones and a-Diketones." 16. Messrs. E. C. C. Baly, W. H. Edwards, and A. W. Stewart, "The Relation between Absorption Spectra and Chemical Reactivity." Part III. "The Nitroanilines and the Nitrophenols." 17. M. Esposito, "Contributions to the Chemistry of the Rare Earths." Part I. 18. G. W. Monier Williams, "A Synthesis of Aldehydes by Grignard's Reaction." 19. Mr. P. Haas, "The Condensation of Dimethyldiydroresorein and of Chloroketodimethyltetrahydrobenzene with Primary Amines." Part I. "Monamines Ammonia, Analine, and *p*-toluidine."

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. M. Gaster, "Russian Broadsides and Illustrated Prints."

Royal Institution, Albemarle-street, W., 5 p.m. Rev. Canon H. C. Beeching, "Shakespeare." (Lecture I.)

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, JAN. 19...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Prof. J. J. Thomson, "Some Applications of the Theory of Electric Discharge to Spectroscopy."

North-East Coast Institute of Engineers and Shipbuilders, Westgate-road, Newcastle-on-Tyne, 7½ p.m. Mr. J. M. Moncrieff, "Commercial Dry Docks."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Wood-carving."

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p m. Mr. F. Lynn Jenkins, "The Consideration of Sculpture by Architects."

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Discussion on "Shear Tests." 2. Mr. Robert A. Bruce, "Worm Contact."

SATURDAY, JAN. 20...Royal Institution, Albermarle-street, W., 3 p.m. Mr. J. E. C. Bodley, "The Church in France." (Lecture I.)

Journal of the Society of Arts.

No. 2,774. VOL. LIV.

FRIDAY, JANUARY 19, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 24, 8 p.m. (Ordinary Meeting.) DR. J. NISBET, "The Planting of Waste Lands for Profit."

THURSDAY, JANUARY 25, 8 p.m. (Howard Lecture.) PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., "High Speed Electric Machinery with Special Reference to Steam Turbine Machines." (Lecture II.)

INDIAN SECTION.

Thursday afternoon, January 18; SIR JAMES L. MACKAY, G.C.M.G., K.C.I.E., in the chair. The paper read was "The City of Calcutta," by CHARLES EDWARD BUCKLAND, C.I.E.

The paper and report of the discussion will be published in a future number of the *Journal.*

HOWARD LECTURES.

Thursday evening, January 18; PROFESSOR SILVANUS P. THOMPSON, D.Sc., F.R.S., delivered the first lecture of his course on "High Speed Electric Machinery with Special Reference to Steam Turbine Machines."

The lectures will be published in the *Journal* during the summer recess.

REPORT ON LEATHER FOR BOOKBINDING.

The enlarged and illustrated edition of the Report of the Committee on Leather for Bookbinding is now ready. It is published by Messrs. George Bell and Sons, of York-house, Portugal-street, W.C., at the net price of 10s. 6d. Members of the Society requiring a copy can obtain one, at a discount of 25 per cent., by applying direct to the Secretary of the Society.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE MEASUREMENT OF HIGH FREQUENCY CURRENTS AND ELECTRIC WAVES.

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

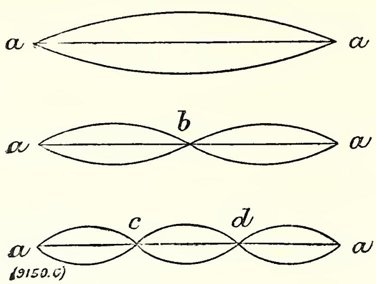
Lecture IV.—Delivered December 18th, 1905.

STATIONARY ELECTRIC WAVES ON WIRES.

In acoustics we are not only familiar with progressive waves travelling through space, but also with so-called stationary waves in pipes or on strings. In the case of an organ pipe there is a variation of pressure and velocity from point to point in the pipe, and in the case of vibrating violin strings there are portions of string in strong movement and portions which are nearly at rest. By properly damping the string with the finger the violinist can cause it to sound not only the fundamental note of the string but also a higher harmonic. In this last case the string vibrates in what are called loops and nodes, the node being the place of small movement and the loop the place of greatest amplitude (see Fig. 29). In the same way in an organ pipe there are loops and nodes of pressure and velocity. At the mouth of the pipe the velocity changes are greatest and the pressure changes are nil, but the range of pressure change is greatest. We can also see the same phenomena on the surface of the water. If we create a splash by throwing a stone on to a lake, we set in motion free waves each travelling over the surface, but we can also set up stationary waves in a finger bowl of water by rubbing the finger on the edge or drawing a violin bow over it. In the some way we cause stationary waves of electric potential to be created on wires, or free waves to move along them.

Consider, then, in the first place, a very long wire immersed in an insulator; it has a certain capacity and inductance per unit of length, and also a certain wire resistance and dielectric conductance per unit of length. If at any point of this wire we apply an alternating electromotive force, then at any instant any section or element of the wire will have a different electric potential in its two ends, and less current flowing out of it than flows into it. The drop in potential is due to resistance and inductance of the wire, and the drop in current down the element is due to its capacity and the conductance of the di-electric. We can easily write down certain mathematical equations which express this fact symbolically. These equations also tell us that the voltage of the current does not instantly appear at all parts of the wire, but that if an alternating electromotive force is applied at one place, the potential and current are propagated along the wire with a velocity measured by $1/\sqrt{CL}$, where C and L denote the capacity and inductance per unit of length of the wire. Also the amplitude of the current and potential is weakened as we pass along the wire, in a ratio depending on R and K, the resistance of the wire and the conductance of the dielectric per unit of length of the wire.

FIG. 29.



VIOLIN STRING VIBRATING IN FUNDAMENTAL AND HARMONICS.

I have designed a model to illustrate this gradual diminution in the amplitude of the potential or current taking place in an infinitely long cable when alternating electromotive force is applied at one end. The model consists of a long steel shaft, having on it a number of eccentric wheels, over which pass strings of equal length carrying weights. These eccentric wheels have progressively less eccentricity as they proceed from one end of the rod to the other, and they are also so set on the shaft that each eccentric is in advance of its neighbour by a certain angle. When the shaft carrying the eccentrics is turned round, the weights on the end of the strings rise and fall with a simple periodic motion, but the amplitude of each bob is less than that of the preceding bob, and there is a shift in phase as we pass from bob to bob. Thus you see when the handle is turned a kind of wavy motion passes along the row of bobs, which is a mechanical analogue of the movement of current in a telegraph or telephone cable.

In the next place suppose that the cable is finite in length, the result then is that the wave of potential or current is reflected at the open end, and by interference with the direct wave produces standing waves of potential, just as when a rope fixed at one end is appropriately jerked at the other. In order that these standing waves may be produced, it is necessary, however, that the length of the finite wire shall bear a certain relation to the wave length of the potential wave on the wire. The distance from one loop to the next loop, or one node to the next node, is called half a wave length, and the relation between the wave velocity, wave length and frequency is given by the well-known formula, *wave velocity = wave length × frequency* Hence, since the wave velocity along the cable is $1/\sqrt{CL}$ if λ denotes the wave length and n denotes the frequency, we must have the following relation :—

$$\frac{1}{\sqrt{CL}} = n\lambda$$

Suppose then that we apply to the end of the cable or wire a high frequency electromotive force with a frequency, n, we can do this by connecting the end of the wire to a condenser circuit having a capacity, C^1, an inductance, L^1, so that the frequency, n, is defined by the equation—

$$n = \frac{1}{2\pi\sqrt{C^1 L^1}}$$

then it follows that the wave length on the wire of which the capacity per unit of length is denoted by C, and the inductance per unit of length by L is given by the equation—

$$\lambda = 2\pi\frac{\sqrt{C^1 L^1}}{\sqrt{CL}}$$

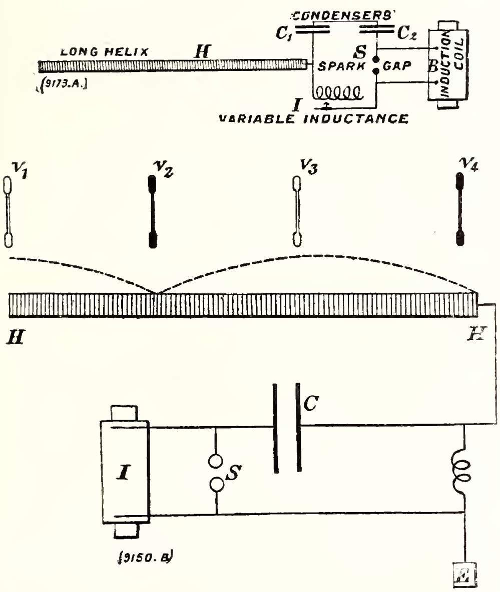
Suppose then that the wire is cut of such a length l, that l bears the following relation to λ—

$$l = \frac{\lambda}{4} = \frac{3\lambda}{4} = \frac{5\lambda}{4} \text{ \&c., \&c.}$$

we shall have stationary waves produced on the wire.

It is very difficult to show this experiment with a straight wire, because, for any frequency which we can command, we need a wire of such an enormous length, since the potential and current travel along the straight wire with the speed of light, but if we wind a fine, silk-covered copper wire in one layer of closely adjacent turns on an ebonite or glass tube, we can make a helix or conductor which has large inductance per unit of length, and hence, comparatively speaking, a small velocity of propagation. It is quite easy to make such a helix as that I now exhibit to you, on which the velocity of propagation is only 150th part of the velocity of light. It is for this helix in question 173×10^6 cms., or about 1,200 miles per second. The helix before you has the total length of 210 centimetres and 5,470 turns of wire. The capacity of this helix per unit of length is $C = 45/10^6 \div 210$ microfarads, and the inductance per unit of length, $L = 32 \times 10^6 \div 210$ centimetres. This helix is supported on insulating stands, and one end of it is connected with an oscillatory circuit consisting of a condenser and variable inductance as shown in the diagram, Fig. 30. By properly adjusting this last-named capacity and inductance, we can create a wave of such length on the helix that the length of the helix is about one quarter of the wave length, and we shall then find that we have a stationary wave produced upon the helix which has a node of potential at the generating end, and a loop or maximum of potential at the far end, and a loop or maximum of potential at the far end.

Fig. 30.



Stationary Waves of Electric Potential established on a Helix by Direct Coupling.

This variation of potential is best shown by means of a Neon vacuum tube which is held near the helix and moved about in the space around. It shows us the distribution of potential by the variation in its glow. We can then vary the frequency of the oscillations in the condenser circuit, so as to make the corresponding wave length on the helix respectively equal to $4\,l/3$, $4\,l/5$, $4\,l/7$, &c., and under these circumstances we find that there are nodes and loops of potential created upon the helix. When the Neon tube is held near a node it does not glow, but when it is held near a loop of potential it glows brightly and we can, as you see, create on the helix stationary electric waves having one loop of potential, two loops, three loops, &c.

The relation between the capacity and the condenser circuit, the inductance of the condenser circuit, and the observed wave length in centimetres on this helix is given in the following Table :—

TABLE V.

Observations made with a Helix of Wire wound on an Ebonite Core, and with an Ebonite Condenser, variable Inductance, and Neon Vacuum-tube to determine the Wave-velocity along the Helix.

Oscillation.	Capacity in mfds. in condenser circuit. C.	Inductance in cms. in condenser circuit. L.	Calculated frequency. n.	Observed wave-length in cms λ	Calculated wave-velocity. $W = n\lambda$ in cms./sec.
Fundamental	0·005835	110,000	$0·197 \times 10^6$	(871)	(172×10^6)
1st Harmonic	0·002887	35,000	0·588 ,,	292	172 ,,
2nd ,, ...	0·001461	18,000	0·977 ,,	175	172 ,,
3rd ,, ...	0·001464	9,000	1·379 ,,	124	171 ,,
4th ,, ...	0·001461	6,000	1·70 ,,	95	163 ,,
5th ,, ...	0·001461	5,000	1·9 ,,	80	152 ,,

From the above Table it is seen that the wave-lengths of the 1st, 2nd, and 3rd harmonics are very nearly in the ratio of 3 : 5 : 7, for $292 \times 3 = 876$, $175 \times 5 = 875$, and $124 \times 7 = 868$. Hence the fundamental wave-length should be 871. If we insert the value in Table V., and calculate the wave-velocity for the fundamental frequency, we find it to be 172×10^6 cms. per second, or exactly the same value as that obtained for the three succeeding harmonics.

Hence, from the fundamental and the three succeeding higher harmonics, we obtain values for the wave-velocity which are closely identical, and equal to 172×10^6 cms./sec., and in very near agreement with the velocity of 174×10^6 cms./sec. calculated from the constants of the helix itself.

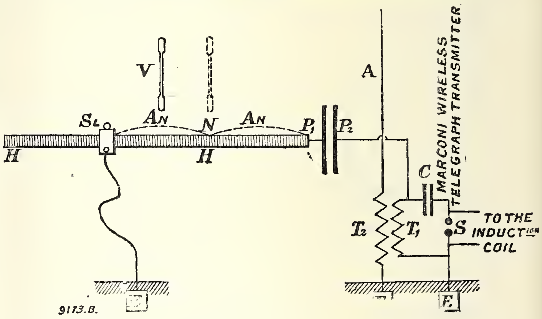
There is a slight falling off in the velocity obtained from the 4th and 5th harmonics, but the difficulty of measuring the small inductance then used in the condenser circuit is considerable.

Hence we may say that when a helix wound on an ebonite core is used, observations confirm theory substantially, and show us that the stationary waves are formed as predicted, the wave-velocity being calculable from the observed inductance and capacity of the helix.

This experiment shows us therefore in a very striking manner the production of loops and nodes of potential of current on a conductor. An interesting point to notice is this, that the current in this long wire is not in the same direction at all parts of the wire at the same time, but there are places on this continuous wire in which there is practically no electric current, and other places not far apart in which the current is moving in opposite directions at the same time.

I have applied such a helix as a means of measuring the frequency in a wireless telegraph antenna. Suppose that we have a wireless telegraph transmitter and we desire to know the wave length radiated from the antenna, we can do it in the following manner. Let a long helix made as described be connected through a small condenser with the antenna and let a metal saddle slide on the helix, the said metal saddle being connected by a flexible wire with the earth. (See Fig. 31.) We can then adjust the position of this saddle so that by means of a Neon tube we have one complete stationary wave as indicated by the dotted line set upon the helix. We can measure the length of this wave and knowing the velocity of propagation along the helix we can calculate the frequency of the oscillations. But this frequency must be the same as that of the oscillations in the antenna, and since the wave length of the wave radiated from the antenna is numerically equal to the quotient of the velocity of light, divided by the frequency, we obtain in this manner the measure of the wave length of the radiated wave. Professor Slaby has employed a helix in the same way as an indicator or measurer of the frequency in a wireless telegraph antenna, only instead of using a metal saddle, he shortens or lengthens the helix, more or less, by holding it in the hand, and instead of using a Neon tube he employs some fluorescent material, having particles of gold leaf disseminated through it, spread on paper fixed near the open end of the helix. When the helix is adjusted to be of such a length that this

FIG. 31.



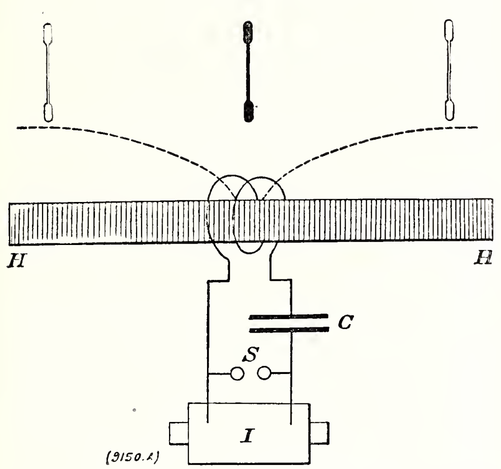
USE OF A LONG HELIX AS A CYMOMETER FOR MEASURING THE WAVE LENGTH OF A WIRELESS TELEGRAPH TRANSMITTER.

fluorescent paper glows most brightly, then it is known that the length of the helix is approximately one quarter of the stationary wave upon it.

It will be seen, therefore, that there are two classes of cymometers or wave metres for measuring long electric waves. First, the open circuit, or helix type, and second, the closed circuit. One of my own cymometers which I have just described to you and also that of Prof. Slaby, is of the open circuit type, and my other form of cymometer and that of Dönitz, are of the closed circuit type. The characteristic quality of my own form of closed circuit cymometer is that in it the inductance and capacity are varied simultaneously, and in the same proportion by one movement of a handle, and that, therefore, an index can indicate directly on a scale the wave length of the radiated wave, and also render the scale showing the oscillation constant

equidivisional. In using any form of cymometer it is essential that we should not alter the quantity we are trying to measure, thus, in using a closed circuit cymometer which is coupled inductively to an antenna, the coupling must be very loose, that is to say, the mutual inductance between the antenna and the cymometer must be small, or else each oscillation in the antenna will give rise to two oscillations of different period in the cymometer, neither of which is that of the antenna, which we are desirous of measuring. Accordingly in my form of cymometer I have so arranged matters that we can get an indication by means of the Neon tube with a very weak coupling indeed between the cymometer and the circuit tested, so that what the cymometer measures is the frequency of

Fig. 32.



Stationary Wave of Electrical Potential established on a Helix by Inductive Coupling.

the oscillation or oscillations which only exist in the antenna when the cymometer is not there.

Similarly, in using an open circuit cymometer we have to avoid producing a change in the capacity of the aerial by an earthed conductor held near it, and so alter its natural time period.

It is easy to avoid the above-mentioned errors with a closed circuit cymometer when using a sensitive detector such as the Neon tube I employ with my form of cymometer. We can also make use of the cymometer shown to you to measure the wave length of the arriving wave as received on the receiving antenna if we substitute a magnetic detector for the Neon tube and coil a few turns of the receiving antenna round the spiral inductance of the cymometer.

If we return again for a moment to the subject of stationary electric waves on spiral wires, I may draw your attention to another method of setting up electrical oscillations on a spiral wire by coupling it inductively instead of directly with the condenser circuit, as shown in Fig. 32. In this manner we can start the free oscillations in a perfectly insulated helix. If we investigate the distribution of potential of current by means of the Neon tube or a hot wire ammeter, we find that in this case both the free ends of the helix are nodes of current but antinodes or loops of potential, and that the centre of the helix, where the inductive coupling takes place, is a place of current antinode and potential node. By appropriately adjusting the frequency of the condenser circuit we can establish harmonic oscillations on such a helix, and make loops and nodes of potential all along it just as in the case of the spiral insulated at one end only.

In this manner of operating the length of the helix proves to be rather less than half the wave-length on the helix.

It has generally been assumed, an d indeed may be shown by a certain simple mathematical analysis, that when oscillations are set up in an insulated linear conductor of the Hertzian type the wave length corresponding to the fundamental oscillation is twice the length of the wire, but it has been shown mathematically by Mr. H. M. Macdonald in his book on "Electric Waves," that the length of waves is really 2·53 times the length of the linear oscillator, and this fact has been experimentally confirmed by Professor Pollock and others.

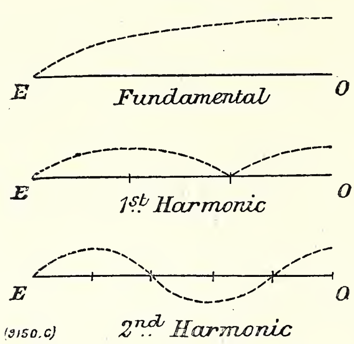
In experiments with helices I have always found that the distance from the open end of the helix to the first potential node is much less than a quarter of the wave length on the helix, that is to say, is less than half the distance between the two next nodes. Thus reverting to the helix of which data has been given to you, the diagram in Fig. 33 shows the distribution of the nodes of potential on the helix for the different harmonics used, and we see that the distance from the end of the helix to the first node is always less than half the distance between the two nodes.

Theory shows that the distance between the first and second nodes is always exactly or very nearly half the wave length, hence it follows that when we set up the fundamental oscillation on a helix by coupling it directly at one end to an oscillation circuit, the length of

the stationary wave established on the helix is more than four times the length of the helix.

In the same way, when a wireless telegraph antenna of the simple Marconi type is in operation, the wave sent off from it is more than four times the length of the wire, and by experiments with the cymometer I have found it is nearly five times the length of the wire, thus supporting the conclusions derived from Macdonald's theory. If, however, we insert in the base of the antenna an inductance coil forming the secondary circuit of a transformer, then the conditions are totally different, and it is a more difficult matter to ascertain the length of the wave radiated by such an aerial.

FIG. 33.



STATIONARY WAVES OF POTENTIAL ON A WIRE.

The circuit of the oscillation transformer adds considerably to the effective inductance of the antenna, and we cannot even say that the radiated wave length is five times, far less four times, that of the total length of the antenna and of the oscillation coil taken together.

From experiments made with the cymometer I have ascertained that when using the ordinary forms of oscillation transformer used in wireless telegraphy the relation between the length of the wave radiated from the antenna to the length, l, of the wire forming the antenna itself and the length, l', of the wire forming the secondary circuit of the oscillation transformer in series with the antenna, is given by an empirical formula of the form

$$\lambda = 5(l + Ml')$$

where M is some number lying between 2 and 5.

The only satisfactory method, however, of measuring the length of the radiated wave is to measure as described above, the frequency of the oscillation in the antenna by means of the cymometer. This of course will tell us where there are oscillations of one or two frequencies in the antenna, and will give us the corresponding wave length for these two oscillations.

In practical wireless telegraphy when using oscillation transformers with a coupling coefficient lying between 0·4 and 0·6, one radiated wave may have from 20 to 50 per cent. greater wave length than the other, and the lengths of these radiated waves are connected with the natural free frequency n of the antenna by the formula.

Thus, for instance, at University College, London, I have an antenna consisting of four aluminium wires arranged fan-shaped, each 50′ 6″ in length conducted by a semi-rectangle of wire, and also connected to the secondary circuit. The capacity in the primary circuit is 1/40 of a microfarad, and the oscillation constant of this condenser circuit, and the antenna, each taken separately, is 6·9, but when the antenna and condenser circuits are coupled together with a transformer having a co-efficient of coupling of 0·5, I find two resultant oscillation constants in the aerial having values 5 and 8·5 corresponding with waves of 1,000 and 1,700 feet long respectively. The longer of these two waves is the more energetic and the less damped, the ratio of the damping being about 3 to 1.

In conclusion, I may indicate a few outstanding problems in connection with the measurement of long electric waves which have not yet recived complete solution. We have much need of a more simple quantitative wave detector which will provide means for determining the maximum intensity and damping of the waves impinging on a receiving aerial. If we possessed this, and had details as to the sending apparatus used, we should have data which would enable us to demermine approximately the distance of the sending stations, provided we were not working over distances at which atmospheric ionisation becomes objectionable.

In the matter of transmitters, the objections to the use of a spark gap are many and serious. It will no doubt be found possible at some time to solve the important practical problem of producing continuous trains of electric waves of known or regulated amplitude. When this is done many other problems will receive solution, but in spite of numerous patents and announcements nothing satisfactory has yet been found. The important practical problem of locating the radiant point has attracted many inventors, and it is

possible that before long a solution may be arrived at in a manner least expected.

Such progress has, however, been made in dealing quantitatively with the problems of high frequency currents and electric waves that we have every confidence that in time these outstanding problems will be successfully solved.

SEVENTH ORDINARY MEETING.

Wednesday, January 17th, 1906; AUGUSTUS D. WALLER, M.D., C.M., LL.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society :—

Banaji, Khoshru Nowrosji, The Commercial Studio, Raopura, Baroda, Bombay, India.

Baylay, Major Frederick, R.E., Brompton Barracks, Chatham.

Bennett, William, J.P., Bank-house, Grimsby.

Chatley, Herbert, B.Sc., Burlington-house, Osborne-road, Southsea.

Claret, William Edward, Tottenham-house, Moulton, Northamptonshire.

Clarke, Archer, 29, Winchester-house, St. James's, S.W.

Craig, Charles William, Southern Punjab Railway, Bhatinda, Punjab, India.

Curtis, Walter Septimus, M.A., 4, Norfolk-crescent, Hyde-park, W.

Davis, George Herbert, 5, Tressillian-crescent, St. John's, S.E.

Duncan, Harold Malcolm, Fairlawn, Weybridge, Surrey.

Dutt, Girindra Nath, B.A., Hutwa Raj, Hutwa, District Chapra, Bengal, India.

Fortescue, Hon. John William, The Library, Windsor Castle, and 59A, Brook-street, W.

Godsal, Capt. William C., Wootton Bassett, Wilts.

Harris, George, 36, Lime-street, E.C.

Hermesson, John Louis, A.M.I.E.E., Santa Lucrecia, Estado de Vera Cruz, Mexico.

Holland, Alfred Robert, Leesons, Chislehurst, Kent.

Jacob, Edwin, 119, Victoria-street, S.W.

James, Alexander Dean, 59, Langdale-road, Thornton-heath.

Kapadia, Framjee Dorabjee, Jumulpoor-gate Calico-mill, Ahmedabad, India.

Littledale, Colonel H. C., care of Messrs. Coutts and Co., 440, Strand, W.C.

Mac Arthur, John Stewart, 74, York-street, Glasgow.

Marris, H. Clifton, 32, Kourlandskaia-street, St. Petersburg, Russia.

Price, R. Arnold, 3, Queen Victoria-street, E.C.

Richardson, Henry Adair, M.A., 7, Canfield-gardens, Hampstead, N.W.

Rothwell, Commander William Henry, R.N.R., care of Messrs. Mackinnon, Mackenzie and Co., Bombay, India.

Sharman, Alexander William, 13, Broderick-road, Upper Tooting, S.W.

Smith, Charles Edward, San Martin 354, Rosario, Argentine Republic.

Tillotson, J. L., Heathfield, Bebrington, Cheshire.

Topham, James Jerom, Laurick, Ridge-road, Durban, South Africa.

Turner, Rev. George Lyon, M.A., Crescent-lodge, St. John's, Brockley, S.E.

Walker, J. Ewart, 2, Pump-court, Temple, E.C., and Mancunium, Anerley, S.E.

Ward, Arthur Egerton Neville, 65, London-wall, E.C.

The following candidates were balloted for and duly elected members of the Society :—

Dickinson, J. H., Litt.D., F.R.S.L., 6, Claremont-terrace, Blackpool, Lancs.

Ericsson, Axel Fredrik, Mayfield, Jesmond, Newcastle-upon-Tyne.

Evans, Edw. A., The Quebec Railway, Light and Power Company, Quebec, Canada.

Johnston, George Lawson, 29, Portman-square, W.

Mawjee, Purshottam Vishram, J.P., M.R.A.S., Vishram Bhuwan, Warden-road, Bombay, India.

Oke, Alfred William, B.A., LL.M., F.G.S., F.L.S., 8, Cumberland-place, Southampton, and 32, Denmark-villas, Hove, Brighton.

Sale, Frederick G., 54, Old Broad-street, E.C.

Singh, H. H. Maharajah Sardar, Jodhpur, Rajputana, India.

The paper read was—

THE SCIENTIFIC ASPECTS OF VOICE DEVELOPMENT.

By WILLIAM A. AIKIN, M.D.

My first intention, in considering the scientific aspects of voice development, is to bring before you as clearly as I can a true picture of what the voice is. There are three factors involved in the sound of it which we must first understand separately :—

1. The Breath.
2. The Vocal Reed.
3. The Resonator.

1. *The Breath.*—The force by which we drive air out of the lungs in the act of "breathing out" is the force which produces the sound of the voice. It is in reality a combination of forces. 1. The elasticity of the lungs and chest walls. 2. The action of muscles of the thorax which depress the

ribs. 3. The action of the muscles of the abdomen which oppose the diaphragm. Their force is transmitted to the sounding mechanism by the compression of the air in the lungs and windpipe.

2. *The Vocal Reed.*—At the top of the windpipe there are two membranes which we can draw like curtains across the whole breath of the tube until their edges meet. These membranes, and especially their edges, are finely elastic. They are immediately thrown into a state of vibration by the air pressure beneath them, so that the minute slit between their edges is alternately opened and closed with great rapidity, and the escape of the compressed air takes place in the form of a very rapid succession of minute puffs. This is the action known in acoustics as that of a "reed," of which this is an example of the membranous variety, and a powerful way of generating sound in air.

It is always well to remember that the vocal instrument, or any other "reed" (which differs only in form from a "siren"), is a mechanism for converting air under compression into rhythmically undulating air—or sound, and that the aerial vibrations are what we actually hear—the vibrations of solid structures being practically negligible as regards their sounding properties.

Without going into the whole anatomy of the larynx I will now only briefly state that there are groups of small muscles which draw these vocal membranes together in the way just described and back again, and others which stretch them tighter and relax them. The tightening and relaxing muscles quicken and retard respectively the rate of vibration of the membrane, and consequently raise and lower the note of the "reed."

The act of making a note is inseparably associated with the act of breathing out. It is also bound up with the mental perception of "sound," for which reason those who are born deaf are dumb also.

When the membranes are not drawn sufficiently near together to be made to vibrate, the air passing between them only makes a rushing sound, sufficient to make audible what is known as the whispering voice.

3. *The Resonator.*—The third factor in the voice. The hollow spaces of the throat and mouth and nose have, like all other open hollow spaces, the property of accommodating within them only those vibrations of the air which are suitable to their size and shape. This is called resonation.

When a rushing sound is sent through resonating cavities they resound or resonate certain characteristic tones, which vary according to the size, and according to the various positions the cavities may be made to adopt.

When the sounding note of the vocal reed is sent through them, the effect is a little more complicated, but the principle is the same. They impress upon the sound of the reed their own characteristics by virtue of this property of resonation. This part of the vocal instrument is, therefore, called the "resonator," and in it are formed all the effects which we recognise as the sounds of language.

Although the resonator can be sounded by itself as in whispering, that is, without any reed note, it is not possible to hear the reed note by itself, since it can never avoid passing through the resonator. Thus it arises that every sounding note or vowel in language is associated with a particular position of the resonator.

In the formation of words we further make use of a variety of movements of the resonator to approach and depart from the vowel positions, producing the sounds, or more properly speaking, the noises of the consonants, which may be regarded generally as interferences with proper resonation. Thus, if I say or sing the word "voice," at the moment of breathing out, the vocal membranes are drawn together and begin to sound whatever note I choose. But the sound is buried because the upper teeth and lower lip are together as demanded by the consonant V. With the opening of the mouth to the position of the vowel O^2 (as in "or") the sound of the voice is set free. This is the principal vowel sound of this word—but it is followed by a momentary change to the position for the vowel I (as in hit), and then the vocal note ceases as the membranes are withdrawn—but the breath continues and makes a hissing sound between the teeth, as the jaw is closed, characteristic of the consonant S. Thus we have the breath supplying compressed air to produce the vibratory action of the "reed." The sound thus generated is set free or interfered with by various actions of the resonator, which also contributes certain independent noises of its own.

This is but a rough picture of the voice before considering it in closer detail. I would, however, remind you first that with the vital function of breathing, the special function of using the vocal reed is born in us, and the majority of mankind give voice to

almost the first breath they ever take—but that the behaviour of the resonator is wholly acquired by education, and must develop exactly under the same conditions as our other voluntary muscular performances.

We may now proceed to examine the details of breath-force, and the two distinct instruments it plays upon—and especially with regard to their development towards a state of physical and physiological perfection, if I may be permitted so far to idealise the process.

The Breath.—The voice requires a large and well controlled volume of air in the chest. Contrary to the normal rhythm of respiration, the intake is usually rapid, and the output carefully distributed over a period which may be as long as fifteen seconds—or even more. Air is drawn into the lungs by the combined action of raising the ribs and contracting the diaphragm—and the greatest volume of air is obtained when both those actions take place in proper proportion. The upper ribs are stiff—and do not repay any attempt to raise them—but the lower, which cover the thicker and more capacious bases of the lungs, are those whose movement is at once easier and more efficacious. The contraction of the diaphragm inflates the lungs by drawing the floor of the chest downwards. This action also compresses the abdominal organs, and should therefore not be carried to its extreme limits. The expansion of the lower ribs, however, increases the abdominal space and allows the diaphragm to descend further without causing undue pressure downwards.

It is usually admitted that when the lower ribs are fully expanded and only the upper part of the abdominal wall—and not the lower—is caused to bulge forwards, a full breath may be said to have been taken. I have myself frequently noticed that the freedom of the operatic stage, where force and length of phrase are most required, leads instinctively to diaphragmatic breathing—beyond the limits suggested by the more constrained and controlled conditions of the concert platform. But the maintenance of an expanded lower chest, and the use of the air over and above that, by the free use of the diaphragm and abdominal muscles, has a decided effect upon the continuity of the air pressure, because the volume of the compressed air remains larger and the expanded walls of the chest support it by their increased rigidity.

This is a condition which many strive for, and which I also advocate. It involves practically, the expansion of the lower chest and upper abdomen on a level an inch, or rather more, below the tip of the breast bone, and maintaining the expansion of the ribs as long as possible. For short phrases the movement is almost entirely diaphragmatic, but in longer ones the ribs begin to descend. This can be made so habitual that the rib expansion becomes more a question of posture than of inspiration.

Medical men and others are sometimes led to condemn diaphragmatic breathing altogether, and I should do the same if the breathing were diaphragmatic only. To exaggerate one side of our power of breathing is obviously unnatural, whether it be in the form of an unduly protruded abdomen or the strained gasping of an unduly inflated chest. When the maximum expansion takes place at the level I have indicated, there can be no doubt that the breathing is then compounded of a fair proportion of both actions—and if for the sake of continuity and control of air pressure, I can reserve the costal air while making use of the diaphragmatic air, I know of no physiological principle which would forbid it.

The Vocal Reed.—Intimately associated with the act of breathing out, is the act of obstructing the air-stream with the vocal membranes. In ordinary in and out breathing the membranes are widely separated during the in-breath, but come nearer together during the out-breath. When we desire to make a vocal sound the latter action goes a step further, and the muscles attached to the moveable cartilages, which hold the posterior ends of the membranes, bring them firmly together. The reed is thus brought into action, and a suitable degree of tension of the membranes by another set of muscles, determines the pitch of the note produced. The whole process is so closely connected with auditory sense or mental perception of sound—that it cannot be regarded as simply voluntary—but rather, instinctive.

When the membranes come together *after* the breath has begun, we hear the effect of an aspirate prefixed to the sound, and if the membranes do not come completely together when vibrating, the escaping air is audible and gives the sound a "breathy" character—a continuous aspirate, which wastes the breath.

The normal attack of the note is made by the complete approximation of the membranes at the moment of the action of the breath. During the sounding of the note, or series of notes, approximation remains complete, and

only the tension of the membranes varies. When the note is finished the membranes spring aside, and usually allow a gush of air to pass out, to relieve the pressure which was making the note.

At this point I ought to mention what is known as the *coup de glotte*, or shock of the glottis, which is a method of attack advocated by those who think more of the strong onset of the note, than of the well-being of the vocal membranes.

We possess immediately above the vocal membranes two muscular folds called the ventricular bands. They form the principal part of what is called in anatomy a "sphincter," or constricting muscle, which is used to close the air passage when the ribs and breath have to be fixed for any great muscular effort—thus saving the delicate vocal membranes from a pressure they could not sustain.

The *coup de glotte* is effected by closing this "sphincter" and so collecting an amount of air pressure to impinge upon the approximated membranes the moment the "sphincter" is suddenly relaxed. After the note has sounded it can be "pinched off" by contraction of the "sphincter."

This method is dangerous to the vocal membranes in possibly subjecting them to too strong and too sudden pressure. It also introduces a voluntary muscular spasm into what is physiologically more of an instinctive act—and dissociates the note from the breath, by interposing an action of the throat which hampers the freedom of the voice. Moreover it often spoils diction by giving emphasis to unimportant words that happen to begin with vowels.

It is possible to produce quite as firm a note by a well directed breath straight upon the membranes, as by means of this common trick, and I prefer to adhere strongly to the natural method even though it may sometimes involve an audible escape of breath *after* the note.

There is another strong objection to the *coup de glotte*. The spasm of the glottis is the cause of increased pressure in the abdomen, which is thus relieved by the onset of the note. This is a fact well known in medical practice, for a doctor wishing to reduce abdominal pressure tells his patient to cry out. In the normal attack the pressure is never greater than that required for the note. The sense of breathing just above the waist is then the only conscious muscular action connected with the production of sound.

The variation of the pitch of the note must depend upon the range throughout which the tension of the vocal membranes can be varied. This is entirely under the control of mental sound perception, and, in order to start a note without any uncertainty or hesitation, it must be heard in the mind beforehand.

The compass of the voice must depend in the first instance upon the size of the vocal reed. The length given in the text-books is is about 5-12th inch for women and 7-12th inch for men. The thickness and breadth have also to be taken into consideration, but the condition of variation by tension are in all voices practically the same. The amount of tension exerted upon the membranes it is not possible to estimate exactly, but if we take the tension required for the lowest note of a given compass as $= 1$, then we know that the vibrations increase as the square of the tension, and the octave of twice as many variations will require four times as much tension, and the octave above that doubles its vibrations by using a tension equivalent to 16.

At the same time as increase of tension, a higher note requires increase of air pressure. This has been roughly estimated as: for a high note, 920 mm. of water; for a medium note, 160 mm. of water; for a whispered sound, 30 mm. of water (as given in Schäfer's "Physiology"), by which it appears that much the same ratio of increase affects both pressure and tension.

In ascribing to a normal cultivated voice a compass of two octaves, I always try to discover the mean whence the vocal notes may be practised both upwards and downwards. I am convinced by frequent laryngological observation that the entire membranous edge vibrates throughout this whole compass in the natural voice, and that "registers," based upon peculiar manners of vibration of the membranes, need not exist.

Only a portion of the *glottis* vibrates. The front ends of the membranes meet and therefore stop vibration for a short distance. The vibrating length of the "reed" is between that and the cartilages at the back. The cartilages are anatomically distinct from the membranes, and do not vibrate with them except perhaps at the tips of the fine vocal processes in low notes, and they form what I have described as a "glottic valve," through which air pressure escapes in a soft, breathy note.

By excessive compression the posterior portions of the membranes can be "stopped," leaving only the anterior portion to vibrate,

and the small high notes so obtained are used by tenors and high sopranos for high piano notes. In bass and contralto voices they are too different in quality to be serviceable. In all voices they must be regarded as something apart from the true natural compass of the voice, which will be without breaks, when it is regulated by change of tension only.

There are undoubtedly different qualities of voice which I shall describe presently in connection with resonation, but during the good many years that I have been observing the normal voice with the laryngoscope, I have never yet met with any evidence of the so-called "thick" and "thin" registers, which are blindly quoted in works on physiology and singing.

In men and women we have every grade of voice, each with its own range of tension and air-pressure, but we usually speak only of three types of each—

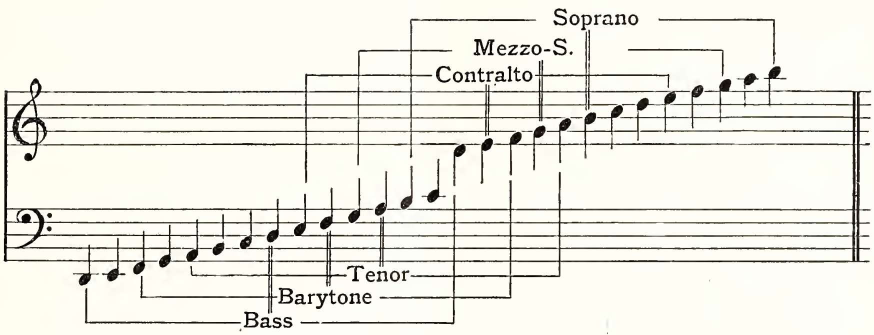
Tenor		Soprano	
Barytone	men	Mezzo Soprano	women.
Bass		Contralto	

Their central notes and compass may be arranged as in Fig. I.

There occur soprano and tenor voices which are naturally a little higher, and contralto and bass a little lower, but the average woman's voice finds its centre between b' and e'—and man's between a and d, and each has to be developed in the same manner both upwards and downwards to the same extent.

When I first studied this point, I was struck by the appropriateness of the various "clefs" to the various types of voices. The modern female soprano fits the present treble clef which is really for the violin, while the mezzo soprano voice has its middle note on the old soprano clef used formerly for soprano voices. The female contralto voice suits what has been a mezzo soprano clef rarely used, but the proper alto clef belongs in compass to the male alto voice which I have left out of our present consideration.

Fig. 1.



The tenor and bass voices both fit the clefs which bear their names, and the barytone would then suit an intermediate clef if ever such existed. They would be written as in Fig. 2.

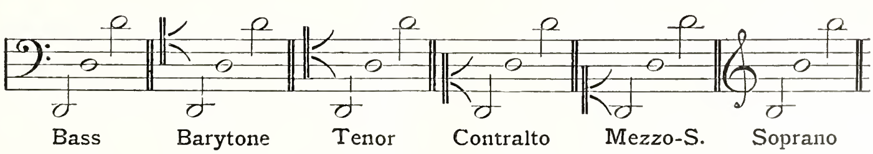
But I have been told decisively, by a well-known English musical authority, that I should be wrong to imagine that the pitch of voices had anything to do with the origin of clefs, and to that authority I must necessarily bow, only I continue to be struck by the coincidence.

The table (Fig. 3, p. 234) represents the working capacity of a singing voice and the conditions which attend it.

To compare the voice with the work it has to perform I make use of a "song diagram," which is a simple estimate of the notes and their duration.

The diagram shows at once the voice to the capacity of which the vocal work is adapted, and betrays unequivocally the severe strain to

Fig. 2.



which some composers subject the voices that interpret their works. It would be a surprise to many composers to know that science goes so far as to measure their "vocality."

I have not yet spoken of the strength of the note. Increased intensity requires increased air-pressure, and is accompanied by firmer approximation of the membranes. Whether there is any adjustment of the tension I am unable to prove. The only conscious action is stronger breath-force—for an emphasis or crescendo—while the pitch is directed by the auditory sense.

So far we have considered the instrument that we play upon instinctively by conscious action of the breath. Now we shall examine the resonator which our education enables us to use almost automatically by force of habit.

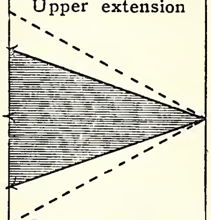
	V	O	A	E	I
Helmholtz	ff′	b′	b	b / f	d / f
Merkel	d	f	a	d	a
König	b	b	b	b	b
Trautmann	f	c	f	a	f

It is certain that every individual can pronounce the vowel sound A (ah) in a variety of ways, that is, with different resonant properties—but when a definite law is followed the resonance becomes much more constant.

The definition of the vowel A (ah) is, therefore, a very important matter, and since we are considering voice development it will not do just to define any "*ah*" we might pick up in the street, but we have to construct a position for this vowel which shall not only satisfy the requirements of the language, but also be

Fig. 3.

Pressure	Tension ratio	Vibrations ratio	Compass	Working capacity	Resonation
Extreme (920)	25	5	Third ↑	Upper extension	Minimum
High	16	4	Octave ↑		
	9	3			
Mean (160)	4	2	Centre ↓		Mean
Low (40)	1	1	Octave ↓		
			Third	Lower extension	Maximum



The vocal reed is virtually the instinctive instrument of the emotions, and the resonator the cultivated instrument of the intellect.

The Resonator.—The positions which produce the vowel sounds owe their characteristic effect to the form of the resonance chambers in each case. There is so much latitude allowed in pronunciation that no estimate of the resonant properties of a vowel-sound can be of value unless it is accompanied by a distinct definition of the manner in which it is pronounced.

Many observers have given us their results relating to resonant notes of vowel sounds—but they differ very widely from one another owing to their having neglected this necessary precaution.

	V	O	A	E	I
Reyher	c	d	a / c	f	c
Hellwag	c	c	f	b	c
Flörcke	c	g	c	a	c
Donders (Helmholtz) ..	f	d	b′ b	c	f
Donders (Merkel)	e / f	e	b	c	f

anatomically, physiologically and acoustically the *best* that we can design. It is generally admitted that the sound we call A (ah) is produced by the most open position of the resonator, so I may proceed to make it as open as is compatible with good resonance within it, without going to extremes or using unnecessary muscles.

The front teeth at least an inch apart.

The *lips at rest* upon the teeth without any retraction or contraction of any kind.

The *tongue* lies flat upon the floor of the mouth with its tip and margins touching the lower teeth. (The base of the tongue is not allowed to ride up so as to hide the throat—nor is it to be dragged down by its own contraction, but takes a middle position allowing the throat and the uvula to be seen from the front—and lies flat and forward in the mouth.)

The *palate* is unconsciously raised to prevent any excess of nasal quality (it is not necessary to cut off all nasal resonance—only it must not be noticeable except when required).

Thus placed, the mouth will represent roughly a hemispherical chamber with a flat floor, a domed roof, and an almost circular opening in front, and with an oval opening at the back passing down into the chamber of the neck, which is composed of the pharynx and larynx.

This second chamber is expanded by holding the head and back straight—by expanding the ribs, and drawing the larynx down by the sterno-thyroid muscles.

Upon the expansicn of this chamber depends much of the resonance of the voice—but it is not essential to the actual formation of the vowels. But when we are endeavouring to establish the best possible resonant positions for the vowels, this chamber must co-operate with the mouth, as you will presently see it can.

The lower chamber is in shape like a bag—narrow above where it enters the back of the mouth and wider below where it includes the larynx, with the vocal membranes in the middle of its floor.

The whole resonator in this position must therefore be regarded as composed of two chambers meeting at right angles by a somewhat constricted orifice in the throat; opposite which point there is a communication with a third chamber—the nose.

The vowel A (ah) is described by Helmholtz and those who copied from him, as being formed by a funnel-shaped chamber increasing "with tolerable uniformity from the larynx to the lips." This is a regrettable anatomical error, and has led to some misunderstanding.

Now, however, we can support the fact of our having a double (or two-chambered) resonator, by demonstrating the nodal point found at their junction. This is especially active when the two chambers act in unison, and gives us additional proof of the futility of dragging down the base of the tongue to enlarge the mouth at the expense of the pharynx.

The tuning fork here used is c'', but you will hear the same note when I tap upon the cheek or in the neck, and it is also clearly recognisable when I simply whisper the vowel in this position.

As we shall examine all the vowels in the whispering voice, I should like to mention that I employ only the smooth whisper of the partly approximated vocal membranes, as described originally by Czermak, and not any of the harsh or shrill varieties produced by constricting or closing the resonator at various places.

Having acquired the position of A (ah) all the other vowels are regarded as derived from it—U (oo) and three kinds of O by degrees of closing the lips—and two kinds of I (ee) and E (eh) and various other sounds by shifting the back of the tongue forwards and upwards.

Fig. 4.

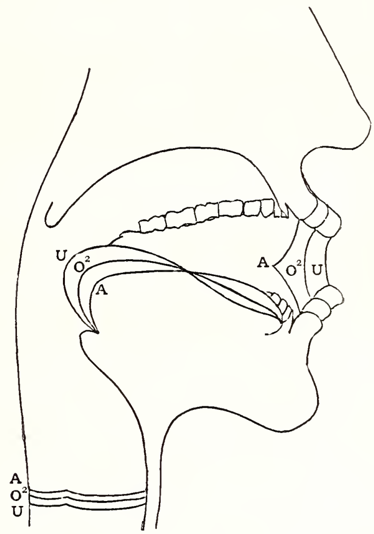
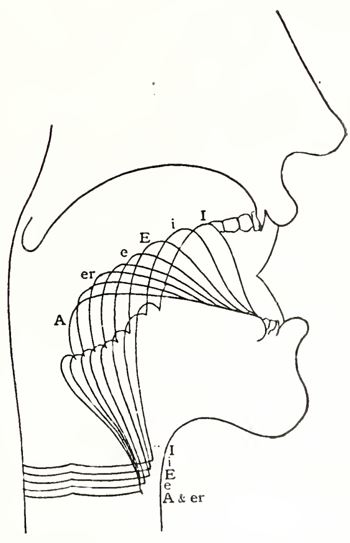


Fig. 5.

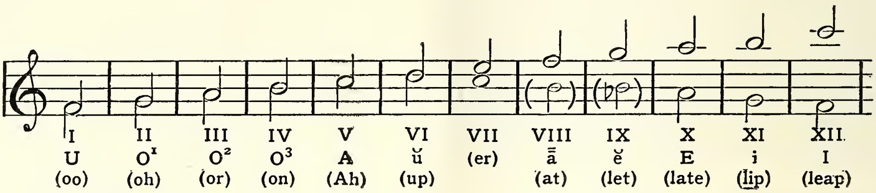


In this manner I have constructed the "Resonator Scale," which is an arrangement of the vowel sounds according to the pitches of their resonant notes—as heard in whispering. By the compensatory actions of lowering the larynx and raising the base of the tongue—the two are kept in unison for

Nos. I.-IV. The unison is continued in VI., because the first forward movement of the tongue only increases the opening between the two chambers, and thereby raises the pitch of both. Later there is an increasing disparity of the two chambers, and the back chamber is sensibly lowered while the front chamber is raised in pitch.

At each successive step the upward scale of the front chamber is made distinctly audible in whispering, and by percussion on the neck the behaviour of the back chamber is easily demonstrated. In the latter the scale rises in I.-VI., and falls again in VII.-XII.

FIG. 6.



The important points of the latter half are the remarkable agreement of the two chambers in X. and XII. where they are as 1 : 2 for E (eh) and as 1 : 3 for I (ee) which points strongly to an inherent acoustical property in those sounds, which have caused the vowels E (eh) and I (ee) to be regarded as pure vowel-sounds in all languages. Whereas the less well-compounded resonances of VI.-IX., include some of the most variable and indefinite sounds peculiar to English and other languages.

I must lay particular stress upon the fact that the jaw remains open one inch between the front teeth throughout the whole scale, and that the lips are used in I.-IV., but not in VI.-XII., which are obtained entirely with the tongue.

The open jaw for U (oo) and I (ee) seems strange at first for those who are accustomed to close their jaws, but it breaks a habit which is destructive to resonance, namely, the common one of speaking through the front teeth.

The pitch of the whispered vowel A (ah) in the instance before you is c″, but it is

possible to make it a few semitones higher by neglecting to expand the pharynx and by retracting the corners of the mouth. The sound becomes then less sonorous, but may not lose its "ah" character. Following the same rules of pronunciation, men are found to vary only by a few semitones in the resonant pitch of "ah," being generally about c″ or c″ sharp. Women, on the other hand, are seldom as low as that, being most often on e″ or e″ flat. Children of both sexes are higher still.

This is another point in which I have had to differ from Helmholtz and those who have received without question his finding the resonances "the same in men, women, and children." It is difficult to understand how resonance chambers so obviously different in size could ever have been thought to be of the same pitch.

Whatever the pitch of A (ah) may be, the resonator scale holds good for every voice, only the whole has to be transposed accordingly. For that reason I make use of the Roman numbers I.-XII., and each number represents therefore a vowel *shape*, which is the real determining cause of the vowel effect, and not a constant resonant note, as Helmholtz and others were inclined to believe.

I always feel it a misfortune to have to disagree with Helmholtz, but, magnificent as his work on sound certainly is, that part of of it which is given to the voice is not always to be relied upon.

The consonants, necessary to the formation of words, owe their character to the various places in the resonator in which they interfere with resonance. I usually classify them according to where they are formed—their physical nature—and the degree of closing of the jaw which they involve. The latter point is of importance in indicating how much opening of the jaw must be rapidly effected to reach a favorable vowel position after them.

The application of these sounding principles to all the elements of speech is too long a subject to enter upon here. But whatever the permutations and combinations of the vowels and consonants may be, the same law holds good that the vowels are the true-sounding

features of words, and that the consonants must be regarded as divisions between them.

The vowels, whether simple or compound or multiple, form the sounding periods during which the vocal note is applied, with the proper breath force, and full resonance maintained. The consonants, single or multiple, divide them from one another in characteristic ways. The aspirates stop the vocal sound by separating the membranes, and the plain explosives do the same by closing the resonator altogether. The voiced explosives allow the vocal sound to pass for a moment into the otherwise closed resonator. The continuous consonants allow the vocal sound to continue, but deflect it into the nose or interfere with it by partially closing the mouth.

French. —Dan | sun | so | mmeil | que | cha | rmait | ton | i | ma | ge.
German. — Ro | se | n bra | ch i | ch Na | chts | mi | ra | mdu | nkle n Ha | ge.
English.—I | ti | sno | tmi | neto | si | ngthe | sta | tely | gra | ces.

Besides the function of forming the words and consonants, the resonator performs also that of reinforcing the vocal notes.

The former, as I have already said, confines itself to the positions and movements characteristic of language—such as would be included in the study of phonetics—but the latter depends upon the physical conditions of size and general formation by reason of which the resonator possesses the virtue of a sounding instrument.

CONSONANTS.

Where formed.	Aspirates.	Continuous sounds with voice.			Explosives.		
		nasal.	non-nasal	roll.	plain	with voice.	
Larynx	H	—	—	—	—	—	} Open jaw
Base of tongue	CH (Scotch)	NG	—	—	K	G	
Tip of tongue	LL (Welsh)	N	L	R	T	D	Very slightly closing if any.
Lips..................	—	M	—	—	P	B	Closing lips, not teeth.
Lower lip and upper teeth	F	—	V	—	—	—	Lower lip between teeth.
Teeth	S SH	—	Z	—	TCH	DJ	Jaw closed.
Teeth and tip of tongue .	TH	—	TH	—	—	—	Tip of tongue between teeth.

Emphasis lies always within the control of the breath, and the expanded position of the lower ribs, in the breathing that I have described, is the principal agent in securing this.

In singing, when the vowel sounds are prolonged upon notes of definite value, whole groups of consonants have to be compressed into small spaces or they might interfere with the melodic form of the music. The Italian "bel canto" demanded this so strictly that it is an open question whether such consonantal and aspirated languages as German and English can be compressed into the same form without losing something of their character. But the more nearly these can be made to approach the Italian system, the better it must be for the sounding quality of the voice. The following examples will explain the comparison—

Italian. —Tu | ma | nca | vi | a | to | rme | nta rmi.

In designing the Resonator Scale I hoped to obtain the good performance of both these functions.

The demonstration of this property of reinforcement is full of difficulty except to those who have developed the power of hearing the harmonics in composite sound. Quite recently I have obtained some encouraging results with a series of wooden resonance boxes fitted with synchronised tuning forks. When the primary note of the box is sounded strongly, the fork is agitated, and continues sounding after the vocal sound has ceased, and thus the harmonics can be identified by any listener. The principle upon which the reinforcement takes place will be seen in the table of my results now shown.

The compass of a man's bass voice barely reaches the lowest resonant note of his resonator scale, therefore it is always a question of harmonic reinforcement. It is extremely interesting to watch how the resonant cavity

FIG. 7.


Resonant pitch whispered
Sing
Harmonic reinforcement.
A (ah)
O² (or)
U (oo)
E (eh)
I (ee)
(Harmonic) No.
8ve.
Vocal Notes.

of a given vowel-sound, partly by the slight latitude given to all reinforcing cavities, and partly by its own adaptability, selects the harmonic which is nearest to it, as it is apparently able to do within the range of four semitones or more. A sound wave is never absolutely free from harmonics in practice, and every ordinary musical note is composed of a primary wave and a succession of subsidiary waves, which represent the division of the primary wave, by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, and so on, except in the case of a stopped organ pipe, which has only the odd numbers 1, 3, 5, 7, 9, &c.

In following the chromatic scale of a bass voice through two octaves from C to c′ (see Table of Harmonics, p. 238), the resonant reinforcement of the five vowels U (oo), O (or), A (ah), E (eh), I (ee), can, with a certain amount of practice, be heard by the unaided ear. When the resonance boxes are used the natural harmonics of the note make the forks respond, but those which are reinforced by the vowel cavities do so with greater force. For instance, if I sing the note F, according to the resonator scale, the vowels U (oo) O (or), and A (ah) are upon f′, a′, c′, its fourth, fifth, and sixth harmonics respectively. The corresponding forks will always answer to the note, but sound more distinctly when the vowel that has a similar resonant pitch is being sung.

Having only a limited number of resonance boxes I cannot verify all the results which I obtained by listening only.

It is a remarkable fact that when the vocal notes rise in the scale, and their lower harmonics, which are at wider intervals, do not come near enough to the vowel resonance—the reinforcement goes immediately to the octave above where the harmonics are closer together, a step which entails the division of the resonant undulation into two.

I have not yet obtained a complete series of harmonics for the female voice with the resonance of A (ah) on e′′b but I have satisfied myself that the principle is the same.

It will be noticed that the resonator not infrequently is so placed that it has the option of choosing the lower or upper of two harmonics by a slight expansion or the reverse. This is the source of much expressiveness of the voice, and I have every reason to believe that, when this analysis has gone further, and our means of demonstration improved, it will be found that what is called "colour" by a singer can be shown to be principally the result of this optional resonation.

There are two common expressions with regard to singing that we so often hear in this connection—that although I carefully avoid all use of terms which have no scientific meaning, I may refer to them now. They are the "head" and "chest" voice. In considering the double nature of the resonator it must not be forgotten that expansion of the lower chamber in the neck is more or less optional. All the vowel sounds can be made in the mouth, and the result of their less powerful resonation gives the voice the effect of being in the "head." When, however, the lower chamber is expanded the fuller resonance obviously comes from lower down, and the expansion of the chest which accompanies it has led to the erroneous belief that the resonation, which is really in the neck took place in the chest. The entire cavity of the lungs and windpipe is occupied with the supply of proper air pressure to the reed, and, forming as it does a closed cavity, it cannot rank as a resonator.

It is a common fallacy to attribute these varieties of colour and tone to the action of the vocal membranes themselves.

The actual frequency of the reed vibration is affected by the rigidity of the chest walls, and this affords a mechanical reason why a high note is assisted by a firm expansion of the ribs—the necessary pressure being made more effective in the absence of any elastic yielding of relaxed intercostal muscles.

I hope I have now carried the explanation of the voice sufficiently far to show that science has at least some right to speak with authority in the matter of its development.

If I have said more about singing than about speaking it is because the acoustic problems of the former are most engrossing. I value both equally, but perhaps give more thought to the teaching of speech because it involves the part of the voice that is the most teachable and the most generally used. They are, however, inseparably bound together, and when I speak of the voice I mean both.

At the present time the voice occupies no place in our system of education.

Speaking and singing are looked upon as an exceptional artistic accomplishment, and the only available vocal training is that offered by the elocutionist and singing-master, which, to say the least of it, is of a very variable quality.

The vast multitude of men and women whose existence practically depends upon the use of their voices, which includes the whole body of

teachers and lecturers engaged in education, the clergy and preachers of all denominations, barristers, politicians, and public officials, actors, and many others, have to pick up what they can, from any irresponsible source, to be of use to them in their vocations. Only singers have what they think is a systematic training.

It is the faculty of speech that is so much neglected, and it has to do with the resonator instrument, which depends entirely upon education for its development. Many people still regard it as a natural gift, forgetting that they spent the early years of their lives in acquiring the habits upon which they still rely to make themselves intelligible to others. Singers give much time, often too much, to the practice of vocalising, because the use of the vocal reed as a musical instrument obviously requires much more perfect execution of notes than ordinary speech. But that is a development by exercise, much more than by education, similar in some respects to the practice of a pianist's hand.

The resonator, on the contrary, cannot rely upon instinct; since it has to adapt itself to the artificial forms of language. Therefore, if it is to be a well-sounding instrument, it must have a physical acoustic principle—similar to that followed by the makers of violins and other resonating instruments, which can only be inculcated by teaching. If educational authorities have hitherto been ignorant of this principle they need be so no longer, for I believe that science is now in a position to offer them one. There is no additional burden put upon education, except that of knowing rather more about what it necessarily has to teach. A child has to be taught its own and other languages, and thus a constant opportunity is afforded for opening the mouth and developing the sounding properties of the voice.

The Latin pronunciation of Latin gives an excellent foundation to the good pronunciation of all langauges, for it contains the sounds that are important to all forms of speech and song. A child learns its alphabet; but how soon does it discover that the letter A is pronounced in six different ways in English? (Wall, what, far, alone, hat, hate.) It is just as true to call it ah (as in father), and found with it the centre of the resonator scale, in common with all other languages.

From this starting point all the other vowel sounds can be properly derived, and the consonants applied to them according to the principles I have already described. This is followed by the formation of words, arranged according to sound. In Engllsh, as we know to our cost, they are spelt in a great variety of ways, which it is better to teach after the sounds have been acquired. This establishes a method in pronunciation which has for its object the full development of the sounding properties of the resonator, which is what every speaker, preacher, teacher, and singer requires.

Naturally, it cannot be accepted by educational bodies on the authority that it at present possesses. For that reason I wish to arouse the attention of scientific thinkers to the study of phonology, by which name I prefer to call the science of the voice. It combines, within its scope, branches of physics, anatomy, physiology, phonetics and philology, with a practical knowledge of elocution and singing.

It is, if I may so, for a Society such as this, to consider the propriety of recognising the study of phonology as a necessary part of the education of:—

1. Those who profess to train the voice.

2. Schoolmasters and school mistresses in general, including teachers in elementary schools and kindergarten.

If only such an authority were established it might procure for the general public some guarantee that they would be the better for teaching, and not, as I regret to say frequently happens, worse. To bring the boon of voice training within reach of preachers and teachers would not only benefit those professions, but would enable them to make much more impression upon their hearers, and so advance the general cause of education considerably. Many admirable men fail as professors, and in other callings, from not being able to gain the attention of their audience, simply because they have never learnt to speak, and others break down in their voices for the same reason.

The testimony of the speaking and singing professions themselves is sufficient ground for some movement in this direction, and to that must be added the experiences of the throat specialists, who have only too many opportunities of seeing the havoc that constant misuse can work in the larynx.

But, as I was saying, what is wanted is a proper authority. Should it be a phonological society? or a phonological committee of the Society of Arts? or of the laryngological society? or what? I only know that an authority is necessary, not only as a guarantee

of good faith in a subject which has been so deeply scarred by charlatanism, but also for the sake of phonology itself.

The science has an extensive field before it in many interesting directions besides the further analysis of vocal sound, such as the fixing of phonological standards of pronunciation, the improvement of musical instruments and the consideration of many other points in connection with vocal music and declamation, &c., which could only be dealt with worthily by a collective assembly.

All that a private individual like myself can do is to place his time and energy at its disposal. But however fortunate one may be in being able to represent all sides of the phonological science, it is only by a decision of a committee, composed of trustworthy representatives of all branches of the question, that our educational bodies can be expected to be moved in the matter.

Some of them have been bitten already by the appointment of incompetent teachers. But how are they to judge? No qualification is necessary to train the voice. The credentials of many teachers are to be found in the advertising columns of the newspapers only. But, it must be remembered, that no qualification is possible, because there is no Body to grant it.

If such a Body existed it could initiate courses of phonological teaching, to be followed by examinations, and the award of certificates. Those who followed such courses would become more valuable as teachers of languages and trainers of choirs; and educational employers would eventually find that out. It would also enable a large number of conscientious singing masters and mistresses, who now only have a musical qualification, to equip themselves properly for their work, as they would gladly do if they could.

After saying so much, and yet omitting so much more, I must leave this matter in the hands of men of science, in the hope that they will determine and finally insist upon the phonological aspects of voice development.

DISCUSSION.

The CHAIRMAN was sure everyone present would agree that the paper had been most instructive and agreeable, consisting of that happy combination of scientific description with an expert knowledge of acoustics, which was so extremely desirable in that department of science. He thought Dr. Aikin had explained to everyone something he or she did not know before, and he was personally glad for the clear idea of the double resonator which had been given in correction of the teaching of Helmholtz. The manner in which the author, by percussion, brought out the notes of the upper and lower part of the double resonator was not only most complete and convincing, but extremely elegant. From the point of view of the Society of Arts, the elegance and perfection of laboratory demonstrations were less to be thought of than the utilisation of them for bringing about an improvement in the use of the voice by children and public men. It was very painful to listen to speakers who had no idea how to emit the voice, and he therefore hoped the movement which was being made towards a better acquaintance with the elements of voice production might be brought about by the efforts of students like Dr. Aikin, and also by the encouragement received at the hands of such an Institution as the Society of Arts.

Mr. HADLEY CARUS said he understood Dr. Aikin to say that there was a natural note in everybody's voice, from which the notes of the scale were taken. Was that the meaning of the resonator scale?

Mr. M. A. ADAM said he understood the author to say that the breathing should take place by means of the muscular projection of the ribs and not necessarily by any further depression of the diaphragm. If the diaphragm should be depressed further, was the depression obtained by the extension of the lower abdominal muscles or not? Dr. Aikin had also spoken of the production of the higher notes of the scale by increasing the extension of the vocal chord alone and the corresponding breath pressure. There was another way in which an increase of pitch could be obtained, viz., by the shortening of the length of the vocal chord. He would like to know how much, if at all, that was employed, or ought to be employed, in singing, and whether it could be done by everybody. If the so-called chest notes of the voice were forced up, was the tendency not to cut the nasal respirator out by the arch of the soft palate, and consequently was not that method of production wrong.

Dr. PEGLER asked whether the nasal cavities and accessory nasal cavities took any part in the work of the resonator, and if so to what extent they contributed to the effects produced?

Mr. MASKELL HARDY said that Dr. Aikin had not referred in the paper to the question of the change of register. When a voice passed upwards, from the low notes to the upper ones, it was said that the pressure and tension greatly increased—would the author explain how it was that a high note

could be obtained with very much less exertion than a lower note by a change in the method of production, and was the change brought about by altering the length of the vocal chord, or was it due to a change in the resonator. Would Dr. Aikin also state whether in taking in a breath during singing the abdomen should be protruded or drawn inwards.

Dr. AIKIN, in reply to Mr. Carus, said he referred to the whispering voice. If he found the vowel "ah" there was a note in it which was the foundation of the resonator scale, and everybody had it as the centre of their resonator scale. It had nothing whatever to do with the vocal note, and it was important to separate the vocal reed and the resonator in all their performances, the resonator being simply an arrangement of cavities which produced the resonant notes of the whispering voice. In order to get at the resonant pitch of the vowels, they had to be whispered. Directly vocal notes were uttered they were all masked, and only appeared in the form of reinforcements; but everybody had a resonator scale, if they only followed the same rules of pronunciation. With regard to breathing, the full use of the ribs and diaphragm constituted the deepest and most easily controlled breath. He did not believe that any great singer or speaker ever produced his voice without using the diaphragm, the diaphragmatic action consisting in the descent of the diaphragm by the contraction of its own muscular fibres. When the muscular fibres of the diaphragm contracted, downward pressure was produced, and the bulging of the abdominal cavity therefore produced by contraction of the diaphragm.

Mr. ADAM asked if it was the author's opinion that there should not be a deliberate extension of the abdominal walls in order to bring down the diaphragm?

Dr. AIKIN replied that it did not bring down the diaphragm, because the abdominal muscles opposed the diaphragm. The out-breath was produced by the abdominal muscles forcing the diaphragm up. He did not at all agree with the idea that the abdomen must be drawn in for a deep in-breath, and he had never met a singer on the operatic stage, who had been able to use such a kind of breathing, and he could not use it himself. He quite admitted that many Italians breathed rather too low, because they used enormous phrases, and were obliged to get all the breath they could by the expansion of all the organs, and that was the only way of getting it, but he considered the descent of the diaphragm to be essential to deep breathing. Two questions had been asked on the subject of the tension of the vocal membranes, and shortening. He had been referring to the normal range of voice, by which he meant the normal range produced by the increase and diminution of tension, but no doubt there was another way. When the vocal membranes were brought together, as shown on the diagram, they produced the normal note; but if the muscles were exerted a little further the posterior ends of the chord were jammed together and stopped, so that only the anterior part vibrated, That was what was produced in a man's voice in a high compressed note, which he did not like to call falsetto because it had been used in so many different ways. He would rather call the compressed or shortened note a note used by tenors and high sopranos for high piano passages. The great singer Caruso used his whole chord when singing the high C, but when singing piano he did not. All singers when using the full volume of the voice should raise the pressure and tension right up to the top, but that was not always done in the concert room because people were afraid to give out the full sound of the voice. With regard to the question of register, he would banish the idea of register altogether from the natural compass of the voice. He would sooner try and develop one without it, because, where tension alone regulated the pitch of the voice, breaks and such things were absent. A great deal had been said about registers which had nothing whatever to do with the vocal chord, but with the resonation. The alternative shallow or deep resonation had been called head and chest. Shallow resonation was called the head voice, but it had nothing to do with the head or chest, except that in the first illustration he had given all the resonation that had taken place in the mouth, and in the second the large chamber in the neck was used in the process. The chest itself was not a resonator of any kind whatever, and the term "chest voice" had been merely given to the voice by singers because they felt the chest was expanded. In reply to Dr. Pegler's question, the actual formative effect of the resonator was limited to the mouth and throat, but there was no doubt that resonation of the voice was very much augmented by the passage of the nose. In forming the vocal "ah" the palate had to be raised a little, but it should only be raised far enough to eliminate the nasal sound when not necessary. Vibration occurred in the nose in all the notes formed in the mouth, but its proportion depended on the opening at the back. A good deal more sound could be introduced into the nose unnoticed by opening the mouth, and the nasal cavity then was extremely important. There were so many nasal consonants in the language so that a singer must always be ready to put on a full nasal sound at any moment, but the difficulty was to hit just the happy medium between the two, which would allow plenty of nasal resonation without the nasal quality becoming prominent. Directly it became prominent it destroyed the purity of the voice.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Dr. Aikin for his instructive and exceedingly interesting paper, and the meeting terminated.

CHINESE BREAD FRUIT.

It has been said by persons living in China that all things considered, the pomelo or Chinese bread fruit, is the finest fruit in the Far East. It combines the good points of the orange with the good points of the grape fruit. It is more easily handled than the orange, and in general description it may be known as a cross between the orange and the grape fruit, but it is probable that if not the original citrus fruit, it is older than either the orange or the grape fruit. Apparently it has been cultivated in China for at least two thousand years. It requires ordinarily only three years to grow the tree from seed to bearing period, although, of course, the first year's crop will be very small, and commercially it will pay to hold back the bearing period for at least a year. The United States Consul at Hangchow says that its bearing period, with ordinary Chinese care, probably ranges from twenty to twenty-five years. The tree apparently grows in any kind of ground, good soil, of course, producing more and better fruit than poor soil, but the habits of the tree require no particular soil or soil conditions. The best pomeloes are grown in the lower portions of Fukien Province, and the upper portion of Kwantung Province. The best pomeloes of the world are said to come from a little valley near Chang Chew, a large Chinese city in the interior from Amoy, which has not yet been opened to foreign trade, the village in this valley, named Po Nan, being the centre of the trade in fine pomeloes. The pomeloes grown there are of exceptionally fine flavour and size, and of splendid and showy appearance; they fetch high prices. So famous are the pomeloes grown there, that each year a special tribute of Po Nan pomeloes are sent to the Emperor at Peking. The summers in this valley are rather hot and damp, while in the winter there are a good many frosts. The temperature will often go as low as 28° Fahrenheit, and has been known to go as low as 25°, although damage was done at that time. The pomelo is grown far in the interior of China, having been reported as common by travellers in even the drier portions of Szchuan Province. The Chinese say that a good sized tree will ordinarily produce from six hundred to seven hundred pomeloes, and when it is considered that many pomeloes will run as large as seven or eight inches in diameter and even larger, it will be appreciated that such a tree is bearing a considerable load. The fruit is more oval than round. The structure and covering also are practically those of the grape fruit except that the skin and pith padding may be somewhat thicker on the average, and the small globules of juice and fibre or "meat" are more perfectly separated. Each section of the fruit contains a large number of seeds, but the seeds are close together on the inner edge of the section of the fruit, and are easily separated from the edible portion without breaking into the juice cells. The Chinese pick their pomeloes, as they do all their fruit, too green to get the best results, and often the quality of the fruit is poor simply because it has not been allowed to properly ripen. This premature gathering of fruit probably also interferes with the maintenance of the highest quality of their seedling trees. Many of the producers practice grafting from trees of unusual merit, but the general rule is to grow trees from the seeds. Early picking also prevents the fruit from keeping as long as it otherwise would, but in spite of green picking the fruit will keep for months. The Chinese have no particular means of caring for their crop. The pomeloes are handled in bags and receive little care. Their keeping qualities naturally could be greatly increased by more careful handling. As it is they are shipped in bags all over China and Japan and to the East Indies, and in spite of rough usage and more or less bruising they keep indefinitely apparently lasting until the demand for them has exhausted the supply.

AMERICAN ELECTRIC TRACTION STATISTICS.

A report* by Mr. A. L. C. Fell, the chief tramways officer of the London County Council, deals with a large number of matters, mostly of a technical character concerning brakes, car shed design, ploughs for electric conduits, motors, wheels, permanent way construction, steam turbines for generating stations, &c. It also contains some interesting statistics regarding the conditions and equipment in London as contrasted with that at Boston, New York, Washington, and Toronto, from which the following items have been compiled:—

Cars, Seating Capacity and Mileage.—The London County Council has 200 56-passenger cars and 200 66-passenger cars, all double decked; in Boston there are no double decked cars but open and closed cars seating from 28 to 60 passengers, the most numerous types being 1,163 closed cars carrying 34 passengers, and 741 open cars carrying 45 passengers each. No particulars are given regarding New York, but the Capital Traction Company at Washington uses closed motor cars, seating from 22 to 40 persons, open motor cars seating 40, and closed and open trailer cars seating respectively 20 and 40 passengers. The cars used in Toronto are of six types, from single truck closed cars seating 25 persons to double truck cars carrying 45 persons, both these classes being convertible and having a larger summer seating capacity. There are also open cars and open and enclosed trailers. The average electric car mileage per day in each of these cities was London 97, Boston 75·80, New York 87, Washington 107, and Toronto 154.

* London County Council, No. 920, report by Chief Officer of Tramways on his visit to America, May, 1905. P. S. King and Son, 2 and 4, Great Smith street, Westminster, S.W. Price 1s. 6d.

Speed Limits.—Within the streets the maximum allowed in London by the Board of Trade is 12 miles per hour, and the time table speed, including stops, is 8½ miles. The speed in Boston is from 8 to 15 miles per hour, and the time table speed is from 9 to 10 miles. In New York a maximum of 16 miles is permitted, the average and time table speeds being 8½ miles per hour. In Washington two maxima are allowed, that of 12 miles within the city limits and 15 miles outside. This gives a time table speed of 8·8 in the city and 13·8 outside. In Toronto there are no speed limits, but the average time table speed is 8 miles per hour. Of course, on elevated and and subway lines higher speeds are permitted.

Receipts.—Of the six different ways in which the receipts from electric traction may be reckoned perhaps the most interestiug are the average earnings per car per day, per car per mile, and per mile of single line.

Average Earnings.	Per Car per Day.	Per Car per Mile.	Per Mile of Single Track.
	£ s. d.	Pence.	£ s. d.
London County Council	4 16 7	11·76	10,039 5 1
Boston	Not stated.	Not stated.	Not stated.
New York	5 5 0	15·30	10,517 10 0
Washington	1 10 0	14.80	7,414 10 0
Toronto	6 2 9	9.7	Not stated.

Average Fare per Passenger. — London has, of course, the most varied schedule of fares ; halfpenny fares cover an average distance of 1,155, but for one penny the average range is 1 mile 1,314 yards : finally for three pence an average distance of six and two-third miles can be covered. The longest halfpenny fare is 1 mile 440 yards, and the longest penny fare 3 miles 468 yards. There are also special workmen's tickets of one penny for any distance beyond the ordinary half-penny stage, with a return ticket for twopence. Boston has a fixed five cent any distance fare, with an extreme range of 15 miles. So far as New York is concerned the payment of five cents suffices to any point on lines owned by the same company. In Toronto a varied schedule exists, ten cents cash being charged for each fare at night. There are also regular and limited tickets for day use. Regular tickets cost four cents each and are available all through the day; limited tickets cost practically three cents each, and can be used between 5.30 and 8 a.m., and between 5 and 6.30 p.m.

Number of Employés.—The total number of *employés* in the service of the tramways department of the L.C.C. is 3,155, of whom 2,953 represent the outside staff. For New York, the round figure of 14,000 is given, and for Washington the more precise figure of 649, in neither case being there any sub-classification as to duties. This appears, however, in the Toronto particulars, where out of 1,703 *employés*, 1,162 are engaged on transportation outside.

HOME INDUSTRIES.

Brewing Figures.—The consumption of beer continues to decline. In actual standard barrels, the figures of last year show a decline of 918,978 barrels, the year 1904-5 accounting for only 34,404,372 barrels as against 35,323,350 in 1903-4. The export trade improved, the 521,476 barrels sent abroad last year exceeding the record of any previous year, but this improvement does not go far to counterbalance the diminution in home consumption. The imports of beer remain insignificant as compared with the total consumption, being only in all 54,309 barrels. There was some activity during the past year in the conversion of private concerns into limited liability companies, and fresh capital has been issued by many old-established concerns. There were forty-five new companies registered during the year, but five of these are connected with brewers' accessories rather than with the actual production of beer. The total addition to the capital employed in the trade was £2,645,600. Opinions will necessarily differ as to the causes to which the comparatively depressed condition of the industry are due, but without touching controversial points it may be safely said that among the causes are—(1) stagnant trade ; (2) reduced spending power ; (3) the increase of local and imperial taxation ; (4) the lower *per capita* rate of wages. If the present promise of improved trade is borne out by the year's results, it is probable that the consumption of beer per head of the population will recover somewhat. There is not sufficient data at present to warrant the assumption that the growth of temperance is the one explanation of diminished consumption.

Insurance Supervision.—So many persons in this country are interested in the good management and stability of American insuranee offices, that it may be useful to note the recommendations of the committee charged with the work of investigating the methods of certain American insurance company officials and the scandals arising therefrom. Among the recommendations the committee will submit to the Legislature are the following:—(1) That policy-holders shall be given an effective voice in the government of the companies ; (2) that policies be limited to certain standard forms, and be safeguarded further than at present against forfeiture ; (3) that the companies be compelled to make an equitable distribution of the surplus to policy-holders at certain periods ; (4) that the companies be obliged to make a greater proportion of their investments in real estate bonds and mortgages ; (5) that the control of subsidiary companies be prohibited, and that deposits with, or loans to moneyed corporations be properly restricted. The committee also recommend provisions requiring such a degree of publicity on the part of companies as will enable policy-holders to be kept informed regarding the management of the companies, together with a uniform system of audits and accounts to be prescribed by the State insurance department—a department, by the way, that does

not seem to exercise any very efficient or appreciable control over the companies. As "Bradstreet" puts it, the policy-holder demands from the State something more than a guarantee of solvency, and invokes the power of the State to shield him more effectively than it has done in the past, and to curb the companies and their directors to the extent of compelling them to audit their assets for his benefit exclusively, and prevent them from diverting funds to the individual undertakings of speculative directors, or to the payment of vast salaries and exorbitant commissions, of gratuities to men of influence, and of contributions for political campaign purposes. Probably the Legislature will do its best to give effect to all these recommendations. Whether it will be successful is another matter.

Mutual Fire Offices.—In the United Kingdom, 1905 saw the last of the independent existence of "mutual" fire offices. In 1904, the Hand-in-Hand was merged in the Commercial Union Insurance Company, and last year the Westminster Fire Office was absorbed by the Alliance Insurance Company. The amalgamation of the County Fire Office and of the Provident Life Office with the Alliance Insurance Company is pending. On the whole, 1905 was a good year for the fire insurance companies. Fire losses were below the average, and in no country was there any grave disaster seriously affecting British offices. The fires and incendiarism in Russia have been very serious, but British offices exclude losses of this character under their policies.

The Shipbuilding Industry—The output of the British shipyards in 1905 was a record one. If the figures are taken separately for England, Scotland, and Ireland, it will be found that there was a substantial increase in the output of the shipyards of all these countries as compared with 1904. In Scotland it rose from 448,235 tons to 587,932 tons; in England, from 849,651 tons to 1,073,309 tons, in Ireland from 78,244 tons to 150,000 tons, or, taking the aggregate output for the United Kingdom, it increased from 1,376,130 tons in 1904 to 1,811,241 tons in 1905, an increase of 435,111 tons, the increase in i.h.p. being 167,506. The figures given above include warships, but the distinguishing feature of the year was the increase in the class of cargo tramp. Last year Messrs. Harland and Woolff took the second place, the largest producing yard in the country being that of Messrs. William Doxford and Sons (Limited), Wear, with a total of 86,632 tons, Messrs. Harland and Woolff coming next with 85,287 tons, and Messrs. Swan, Hunter, and Wigham Richardson being third with 74,424 tons. An immense tonnage of the "tramp" order has been placed, and it is expected that half a million tons will be in the water before the new year is far advanced. The explanation of the large building of cargo tonnage is to be found in the general belief that the world is on the eve of a great development of trade in all directions, which in turn assumes that the peace of the world is not likely to be broken by any serious war. But, even with peace maintained, and a considerable development of trade, it would seem as if the new tonnage in or about to be in the market is so large that shipowners will find it difficult to get anything like remunerative employment for it.

Timber Imports from Canada.—It is satisfactory to learn that the Dominion Government has decided to grant no more new timber "limits," and that in the renewal of old leases provision will be made for the re-foresting of certain portions of the land. If things had been allowed to go on as they were going, the Canadian forests, upon which the United Kingdom depends so largely for its supply, would have been very seriously effected. Vast tracts of the forest lands of Canada have been bought or leased by American companies for the purpose of producing wood pulp, and the Canadians have only just realised that they are rapidily losing their forests. A single American company possesses over 3,200 square miles of forest land in the Province of Quebec alone; another possesses over 1,700 miles. Other large tracts have been bought up by American companies in order to produce wood pulp, and until now it has been easy for such companies to obtain large grants of timber land, whilst in Eastern Canada many thousands of acres of forest have been destroyed. In future the Dominion Government will only renew old leases where provision is made for the re-foresting of certain portions of the land; and, as has been said above, there are to be no more new timber "limits."

Cotton Profits and New Mills.—There is still considerable doubt as to the extent of the American cotton crop output for 1905, but there can be none as to the exceptional character of the profits of the cotton industry in this country for the past twelve months. The profits made, as shown by the reports of joint stock companies, have been unexampled in recent years, and the building of new spinning mills and loom sheds goes on apace. Mr. William Tattersall, a recognised authority on the subject, gives details of 66 new spinning factories showing 5,850,000 spindles. These mills are estimated to cost about seven millions sterling, and will give employment to upwards of 13,000 operatives. Seventeen of the mills are already at work, and the rest are expected to be in operation not later than October. The number of new looms is put at 45,000, which will cost £1,250,000, and find work for nearly 13,000 hands. Altogether it has been a most prosperous year, and the immediate outlook is good. But the industry can never be on a thoroughly sound and safe basis whilst Lancashire depends so largely as at present upon the United States for its cotton supply. The world's demand for raw cotton is constantly on the increase, whilst the home demand in the United States is growing with equal or even greater rapidity. Yet there is no proportionate increase in the American

supply, and indeed last year, when the American crop was much above the average, it was seriously proposed by cotton planters to destroy a portion of the crop rather than let it affect prices. Efforts are now being made by Lancashire capitalists, tardily but with some vigour, to increase the supply of cotton from within the British dominions, and these efforts are meeting with a measure of success, but it is to be feared that it will be many years before Lancashire ceases to be in perilous dependence on the United States for its raw supply of cotton.

Fruit Growers and Telephones.—The Board of Agriculture and Fisheries has been questioned with respect to the recommendation made by the Departmental Committee that recently inquired into and reported upon the fruit industry, that there should be further extension of the telephone system in the country with the object, among other things, of benefiting fruit growers, and replies that the Post-office is building up local exchange systems in rural districts as quickly as possible. The telephone might be of great use to fruit growers. By its means one of the difficulties of getting into touch with the dealers in small towns would be met. For example, the small dealer in Evesham now probably sends to Manchester or Sheffield, two large centres which supply a large number of small towns. It would be a great advantage to the fruit grower if he could, by starting markets in the small towns, send direct to the small markets, and the telephone would assist him to do this. The dealer would be able to telephone to the fruit grower every evening, or early in the morning, his requirements for the day, and the grower would be able to despatch exactly what was wanted direct. What is required is a general extension of the telephone system in rural districts, and special facilities to fruit growers and farmers for the acquisition of telephones. It is believed that during the last ten years, and in some districts, the increased distribution of fruit, owing to the telephone, has been as much as from 20 to 25 per cent., especially in remote districts where there are no markets. The telephone conduces to better distribution, and an increased price for the produce. At present the cost of the telephone service stands in the way, but it may be hoped that with the Government acquisition of the telephones this difficulty will be got over.

CORRESPONDENCE.

OLD SILVER PLATE.

In reply to the letter from Mr. L. A. Crichton on my article on "Old Silver Plate," he appears not to have seen specimens bearing both marks, but this does not make my statement incorrect. I have not only seen them, but have had them in my possession, therefore my statement respecting this is correct.

He is quite right in saying that the Sovereign's head was introduced in 1784 to denote that duty had been paid, but it was also "as a means of identification," as stated in my article.

Mr. Crichton positively asserts that the lion passsant was introduced in 1544. In this he is too definite, as no one knows exactly when it was introduced. The statutes are very vague on this point, and it is not possible to find from them in exactly what year it was instituted. There is mention in a statute of 1545 of this mark being already in existence, but whether commenced in the same year or previously is not stated. Specimens have, however, been found between 1542 and 1545, and, therefore—because of the reference in the statute of 1545, which is the first I could find on this point—I said "1545" in my article; and, because of the plate already known to exist bearing this mark previous to this date, I inserted, in parenthesis, "or between 1540 and 1545," therefore my statement is quite correct.

JOHN MASTIN (R.B.A., F.R.M.S., &c.)

Woodleigh House, Totley Brook, near Sheffield,
January 15th, 1906.

GENERAL NOTES.

FIBRES.—In reporting upon the British Central African Protectorate for the year 1904-5 (Cd. 2684), the Acting Commissioner says that steps have been taken by the Scientific Department to bring into cultivation some of the local wild fibres, which are of considerable commercial importance, and which may be expected shortly to to enter into the list of exports. The most abundant are two plants yielding a fibre of the jute class, "Denji" and "Nsonogwi," which have been identified at Kew as *Sida rhombifolia* and *Triumfetta rhomboides* respectively. The analysis of these fibres by the Scientific Department of the Imperial Institute shows that "Dengi" is comparable with fine Indian jute. Steps have been taken to obtain a ton or two of each fibre to forward to London, to ascertain their behaviour when worked by machinery. Experience during the year has shown that the best results are to be obtained from sowing "Denji" seed in May or June, so that the young plants get a fair start before the rainy season commences, during which growth is very rapid and strong. A comparison with jute seed sown at the same time showed "Denji" to be more satisfactory, as a period of dry weather for a month or two did not affect it, whilst jute succumbed during the hot weather of October. Another fibre, the existence of which in large quantities in the Protectorate promises to be of considerable economic importance as a competitor with flax, is known locally as "Buaze," and identified as *Securiduca longipediculata.* "Buaze" is largely used by natives for the manufacture of fishing nets.

THE SHARK FISHERY.—Reporting on Somaliland (Cd 2684) the Acting Commissioner says that if the seafaring Somali tribes were not restrained by conservatism and a dislike to a toilsome and unpleasant occupation, the shark fishery, which produces several valuable commodities, would become a lucrative trade industry. Ten to fifteen fishing dhows from the Arabian coast, mainly from Sur, visit the fishery during the trading season, and carry on their operations ten miles to the east and usually sixty miles north-east of Berbera. Within these waters it is estimated that annually 1,000 sharks, averaging 4 feet to 5 feet in length, are hooked or netted, and of the five squalidæ known to the natives the Abu Karnain, the two-horned or hammer-headed, is the commonest catch. From six fish, each measuring about 6 feet, five gallons of "seefa," or liver oil, are extracted by boiling, and the thick liquid purified by straining through matting. The lubricant, packed in petroleum tins, is used for caulking country craft, and the price per tin (four gallons), purchased direct from the fishermen, is 1 rupee 4 annas: but in the town, only a mile distant from the spit, where the crude manufacture is carried out, the cost is 3 rupees to 3½ rupees, although there is not an octroi on its transit. The body, including the fins and the tail, which are considered the most succulent parts, is salted and dried in the sun, the fresh flesh cut into pieces, and sold in the bazaars for 1½ rupee per 28 lbs., or half the cost of the cured; and the spine and the jaw, if the latter is large, are kept to be vended as curios at Aden. Embryo sharks are eaten by the Arabs as an aphrodisiac, and popular superstition assigns equal potency to the vertebra worn as a girdle round the waist.

BECHUANALAND.—The Resident Commissioner's Report on the Bechuanaland Protectorate (Cd. 2684) shows that progress in the territory is but slow. The Protectorate is still unable to make receipts balance expenditure. The revenue collected in 1904-5 was less than in 1903-4—£30,776 as against £32,443; the expenditure was also lower—£78,261 as against £82,938; but the deficit was £47,485, which had to be partly met by a grant in aid of £15,000 from the Treasury. The purchasing power of the Protectorate has been seriously reduced by the closing of the Cape Colony as a market for its cattle, its principal source of wealth. . . . There was fear of East Coast fever. Agriculture is confined almost entirely to the natives, and is carried on in a very primitive way. Little is grown but mealies. No manure is used, nor irrigation attempted. Tree stumps are not removed, and may be seen sticking up amongst the crops in every patch of cultivated ground in the country. There are no manufactures. Recently some efforts have been made to revive the gold industry, but without much success. The climate, save for a few weeks in the year, is "extremely hot," and there is, during a portion of the year, "a great deal of fever." There is no Public Debt, thanks to the Imperial Treasury. The upkeep of the police force "more than absorb the whole revenue of the territory."

THE RAVAGES OF LOCUSTS.—Mr. Consul Stevens, in his report on agriculture in the Trans Caucasus for the year 1905 (No. 3514, Annual Series), refers to the ravages of locusts. The fields situated along the stretch of land north and south of the river Kura are often visited by this insect at a season of the year when, in view of the forward state of the crops, their presence proves most disastrous to the population. The Government has for some years been paying considerable attention to the destruction of locusts, and with this object in view has endeavoured to encourage the peasants to destroy locusts' eggs, or the larvæ. Accordingly the peasants dig holes or trenches, and during the months of June and July the villagers go out into the fields and drive the larvæ into the trenches. This measure has been crowned with a certain amount of success during the present season, and the havoc done to the crops by locusts has thereby been reduced to a minimum. No fewer than 13,905,276 days' *corvée* work was done between the years 1898 and 1904 in destroying locusts in the Sir. Darya, Samarkand, Ferghana, Semirechi, and Trans-Caspian districts. This in itself shows the immense sacrifices the natives are called upon by the authorities to make in connection with the destruction of locust eggs, seeing that in seven years nearly 14,000,000 days were employed in this work, which, if calculated at the rate of R. 1 per man, represents a loss of R. 14,000,000 to the peasants of Central Asia. Between the years 1900 and 1905 the rural authorities of those localities also paid away sums to the amount of £80,000 for the destruction of locusts, and yet during this period the crops in Central Asia were damaged to the extent of £150,000 by this terrible insect.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 24.—"The Planting of Waste Lands for Profit." By DR. J. NISBET. H. W. ELWES, F.R.S., will preside.

JANUARY 31—"The Garden City and the Cheap Cottage." By THOMAS ADAMS.

FEBRUARY 7.—"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E. SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

FEBRUARY 14.—"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON. COLONEL H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 21.—"The Fisheries of the North Sea." By WALTER GARSTANG, M.A. EDWIN RAY LANKESTER, M.A., LL.D., F.R.S., will preside.

FEBRUARY 28.—"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.). SIR JOHN WOLFE-BARRY, K.C.B., LL.D., F.R.S., will preside.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

February 15.—"The Navigable Waterways of India." By Robert Burton Buckley, C.S.I.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

February 6.—"Imperial Immigration." By Octavius Charles Beale, President of the Federal Council of the Chambers of Manufactures of Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock:—

January 30.—"Chemistry of the Painter's Palette." By J. M. Thomson, LL.D., F.R.S.

February 20.—"Illuminated Manuscripts." By H. Yates Thompson, F.S.A.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

Sir William White, K.C.B., F.R.S., "Modern Warships." Five Lectures.

Lecture I.—January 29.—Characteristic features of warships—Materials of construction—Structural arrangements—Operations of building and launching.

Lecture II.—February 5.—Armour protection—Systems of disposition—Methods of manufacturing armour plates—Recent improvements in quality, and consequent changes in designs of warships.

Lecture III.—February 12.—Armaments—Progress in the design and manufacture of guns, mountings and machinery for working heavy guns—Improvements in projectiles and explosives.

Lectures IV. and V.—February 19 and 26.—Recent types of warships, British and Foreign—Battleships—Armoured and protected cruisers—Scouts—Torpedo boats and destroyers—Submarines.

Howard Lectures.

Thursday evenings, at 8 o'clock:—

Professor Silvanus Thompson, D.Sc., F.R.S., "High Speed Electric Machinery, with special reference to Steam-Turbine Machines." (Three Lectures.)

Lecture II.—January 25.—*Turbo-dynamos.*—The problem of commutation—Use of carbon brushes and of metal brushes—Natural and forced commutation—Peripheral speed in relation to commutation—Loading of armatures—Armature distortion—Limits of design as affected by permissible temperature-rise and by sparkless commutation under all loads—Problem of centrifugal forces as affecting dynamo design—Turbo-dynamo designs.

Lecture III.—February 1.—*Turbo-alternators.*—Relation between frequency, number of poles, and revolutions per minute—Relation between frequency, surface-speed, and pole-pitch—Turbine speeds and field-magnet design—The limitations of magnet design—Balancing—Armature-design in alternators—Nature of armature reaction—Armature-design as affected by power-factor of the load—Mechanical considerations—Ventilation of turbo-alternators—Forced ventilation—Efficiency; overload possibilities; limits of design—Excitation of field-magnet system—Preference given to very low voltage of excitation—Examples of turbo-alternators.

MEETINGS FOR THE ENSUING WEEK.

Monday, Jan. 22...British Architects, 9, Conduit-street, W., 8 p.m. Messrs. Swan, Fordham, and Gilbert, "Metalwork."
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. W. St. S. Aubrey, "The Inner Life of the House of Commons."

Tuesday, Jan. 23...Royal Institution, Albemarle-street, W., 5 p.m. Prof. E. H. Parker, "Impressions of Travel in China and the Far East." (Lecture II.)
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Civil Engineers, 25, Great George street, S.W., 8 p.m. Discussion on papers:—"The Elimination o Storm-water from Sewerage Systems," by Mr. David Ernest Lloyd-Davies. "The Elimination of Suspended Solids and Collodial Matters from Sewage," by Lieut.-Colonel Alfred Stowell Jones and Dr. William Owen Travis.
Anthropological, 3, Hanover-square, W., 8½ p.m. Annual Meeting.

Wednesday, Jan. 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Dr. J. Nisbet, "The Planting of Waste Lands for Profits."
Geological, Burlington-house, W., 8 p.m.
United Service Institution, Whitehall, S.W., 3½ p.m. Colonel J. E. Capper, "Military Ballooning."
Royal Society of Literature, 20, Hanover square, W., 8½ p.m.

Thursday, Jan. 25...SOCIETY OF ARTS, John-street, Adelphi, W.C. 8 p.m. (Howard Lectures.) Dr. Silvanus Thompson, "High Speed Electric Machinery, with special Reference to Steam Turbine Machines." (Lecture II.) "Turbo-Dynamos."
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 6 p.m. Mr. M. N. Drucquer, "Legal History of Trade Unionism."
Royal Institution, Albemarle-street, W., 5 p.m. Rev. Canon Beeching, "Shakespeare." (Lecture II.)
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. F. W. Carter, "Technical Considerations in Electric Railway Engineering."

Friday, Jan. 26...Royal Institution, Albemarle-street, W., 9 p.m. Mr. A. C. Benson, "Walter Pater."
Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) 1. Mr. T. R. Grigson, "Prince of Wales Pier, Falmouth." 2. Mr. H. O. H. Etheridge, "Ferro-Concrete Pier at Purfleet."
Botanic, Inner Circle, Regent's-park, N.W., 4 p.m.
Clinical, 20, Hanover-square, W., 8½ p.m.
Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

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FRIDAY, JANUARY 26, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, JANUARY 29, 8 p.m. (Cantor Lecture.) SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." (Lecture I.)

TUESDAY, JANUARY 30, 8 p.m. (Applied Art Section.) PROFESSOR J. M. THOMSON, LL.D., F.R.S., "The Chemistry of Artists' Colours in relation to their Composition and Permanency."

WEDNESDAY, JANUARY 31, 8 p.m. (Ordinary Meeting.) THOMAS ADAMS, "The Garden City and the Cheap Cottage."

THURSDAY, FEBRUARY 1, 8 p.m. (Howard Lecture.) PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., "High Speed Electric Machinery with Special Reference to Steam Turbine Machines." (Lecture III.—Turbo-Alternators.)

Further details of the Society's meetings will be found at the end of this number.

COLONIAL SECTION COMMITTEE.

A meeting of the Committee of the Colonial Section was held on Tuesday afternoon, 23rd instant. Present: SIR WESTBY B. PERCEVAL, K.C.M.G. (Chairman of the Committee), in the chair, Byron Brenan, C.M.G., Hon. Sir Charles W. Fremantle, K.C.B., Robert Kaye Gray, W. L. Griffith, Alexander Siemens, Sir Frederick Young, K.C.M.G., with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section.

HOWARD LECTURES.

On Thursday evening, 25th inst., PROFESSOR SILVANUS P. THOMPSON, D.Sc., F.R.S., delivered the second of his course on "High Speed Electric Machinery with Special Reference to Steam Turbine Machines," the subject being Turbo-dynamos.

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

EIGHTH ORDINARY MEETING.

Wednesday, January 24th, 1906; HENRY JOHN ELWES, J.P., F.R.S., F.L.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Bayliss, Alderman Thomas Richard, J.P., Belmont, Northfield, Worcestershire.
Berridge, Mrs. Agnes, 49, Rutland-gate, S.W.
Cadbury, Barrow, Southfield, Wheeley's-road, Birmingham.
Clark, Charles James, A.R.I.B.A., 46, High-street, Bloomsbury, W.C.
Eaton, Edmund, Battenhurst-park, Ticehurst, Sussex.
Frost, Joe, A.M.I.E.E., 4, Peking-road, Shanghai, China.
Hankin, Dr. E. H., M.A., Office of Chemical Examiner and Bacteriologist, Agra, India.
Marshall, Mrs. A. Campbell, Freshfield, Waterlooville, Cosham, Hants.
Reckitt, Miss Juliette, Mayfield, Dulwich-wood-park, S.E.
Robson, Thomas Conyers, P.O. Box 946, Pretoria, Transvaal, South Africa.
Woltereck, Herman C., Ph.D., 3, Edinburgh-mansions, Howick-place, Westminster, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Arkell-Hardwick, Alfred, Arkell, Muswell-hill, N.
Craggs, Henry Foxton, J.P., 156, West-hill, Putney, S.W.
Lillie, George Ernest, Bhavnagar Para, Kathiawar, India.
Sparling, Augustus Henry, Aligarh, United Provinces, India.
Suares, Felix, Messrs. Suares Frères et Cie, Cairo, Egypt.

The paper read was—

THE PLANTING OF WASTE LAND FOR PROFIT.

By Dr. John Nisbet.

In view of recent publications, including papers read before this Society, no preamble seems necessary in the way of describing the national benefits ultimately obtainable from the formation of extensive timber-plantations to be managed on business principles. So far as economic considerations regarding the future are concerned, it seems to be the duty of the State to make adequate preparations and provisions for ensuring supplies of timber of home-growth; but, besides such direct action, something should also be done by the State to provide substantial encouragement to corporate bodies and private landowners who may be desirous of forming timber-plantations on portions of their estates.

That extensive plantations, formed and worked on business principles, would serve a substantial purpose in the general development of the country is self-evident; but what, up to the present, seems to have received little attention from the different advocates of planting is that any such scheme of national utility should be properly based on broadly comprehensive and systematic lines, capable of providing both for State-action and for the encouragement of private enterprise—because both of these cases can be provided for just as simply as either of them separately. Hence, as a practical contribution towards this important question, I wish to-day to consider the following points, as briefly as possible, in the hope that they may perhaps be found worthy of the attention of Government, because the recommendations about to be made deal specifically with the very important matters slurred over as "Minor Considerations" in the Report of the Departmental Committee on Forestry, 1902:—

1. What scope is there for planting with profit on the waste lands in the United Kingdom?
2. What encouragement has the State hitherto given towards such planting?
3. Can we learn anything of practical use to us from what has been done in foreign countries?
4. What can the Government be reasonably asked to do in this direction by way of legislative amendments and administrative improvements, so as to provide efficient machinery for the acquisition and planting of waste land by the State, and the encouragement of planting by corporations and private land-owners?
5. How should waste land be planted for profit?
6. What will be the probable cost of planting, and what are the prospective returns from the thinnings and the mature timber-crops?
7. What would be the national-economic effect of such plantations?

1. *What scope is there for planting with profit on waste land in the United Kingdom?*—There is now, and there has always been for centuries back, a wide field for planting for profit, but want of funds has ever been the chief obstacle to this. In 1810, Lord Melville urged upon the Prime Minister (Mr. Perceval) the desirability of planting waste land owing to the advance in the price of pine and fir-wood, and in the demand for oak, and he estimated "that certainly not less than 20 millions of acres are still waste." This estimate corresponds with that made by various persons, from time to time, and accepted by the Departmental Committee, 1902—"There is in these islands a very large area of waste, heather, and rough pasture, or land out of cultivation, amounting in all to 21 million acres, on a large proportion of which afforestation could be profitably undertaken." But the circumstances of landowners are much the same to-day as they were ninety years ago:—"Such lands, it must be owned, are sufficiently abundant, but the great expense and slow returns of planting are inconvenient to the majority of land proprietors. . . . The expense of planting is immediate and certain, the profit distant and precarious" (*Quarterly Review*, 1813, Vol. IX.).

That our waste lands and poor pasturages offer a wide field for planting is undoubted; but until the Land Statistics Department has compiled and published a statement of areas presumably suitable for planting, it is only a matter of rough conjecture to hazard any opinion as to what proportion can be planted with any reasonable chance of profit. On the basis of an examination made over several adjoining counties in S.E. Ireland, I should estimate that at present only about one-fifth of the total area classed as waste land is plantable with a fair chance of profit—though this might easily be very much higher in localities within easy and cheap access of wood-consuming centres (such as coal-mining districts), and though ultimately the plantable area might

also be largely increased when once such first plantations provided shelter, and created or improved a local demand for timber. A large proportion of our waste lands is above the 1,000 feet contour line, and in the open, windswept, unsheltered condition of the country very little of this higher land can possibly be planted at present with any fair chance of profit; while there is also a large percentage of peat-bogs where no timber-crops will thrive until the bog is cut away so far as to allow the young trees to get their roots down into the mineral soil. It is just as impossible to grow timber with profit on deep bogs, as on bare windswept mountain slopes having little or no soil left on them.

Assuming, however, the total area now plantable with a fair prospect of profit to be about one-fifth of the waste land throughout the whole of the United Kingdom, this means that there is scope for planting to the extent of over $3\frac{1}{3}$ million acres (see table), which can be begun as soon as ever funds are obtainable for

	Waste lands.	Probably plantable with a fair chance of profit.
	Acres.	Acres.
England........	2,305,823	461,164
Scotland	9,374,512	1,874,902
Wales	1,250,813	250,162
Ireland	3,779,640	755,928
Total	16,710,788	3,342,156

this purpose from either public or private sources. And this would mean a total investment of about £20,000,000 spread over whatever number of years (say 20 or 30, to 40 or 50) might be taken in completing operations (see Para. 6). But, even if such a total area were well-stocked, and the old portions mature, the yield would be less than half the amount of pitwood-timber annually required by our coal-mines alone.

2. *What Encouragement has the State hitherto given towards the Planting of Waste Land for Profit?*—The only answer to this is—None at all. Provisions have been framed under the "Settled Land" and other Acts for permitting trustees to grant money for planting, but no State-encouragement whatever has yet been given; and, in fact, the reverse is the case, owing to the abolition of the timber-import duties. In 1848, some of the preferential duties on foreign timber were removed; in 1851, further similar changes were made; and in 1866, Mr. Gladstone "swept away the last of the old vexatious duties on timber," when "the last tax on raw material vanished with the repeal of the duty on timber" (Morley's "Life of Gladstone," 1903, Vol. II., pp. 68 and 200). Neither at these times, nor subsequently, was any sort of compensation given to landowners for such virtual depreciation in the value of their planting investments, previously made, and of a permanent nature not capable of being reconverted into money and otherwise invested; and, since then, legislation affecting rates and taxes, estate and succession duties, &c., has added to existing burdens, in place of offering encouragement to the planting of waste lands.

The real fact of the matter is that the nation is almost apathetic about timber. Improved communications by land and water, iron steamships and railways, and free imports have obliterated the memory of what a burning question the subject of timber long was in Britain. It was never a party question; for two hundred years it touched the vital interests of the nation too closely for that; and now, because it is non-party and non-political, it is almost absolutely neglected. And the direct consequence of this is that, even if large landowners had funds and desired to plant extensively (though few of them have, unless they also own rich estates or coal-mines, &c., because planting investments are usually unremunerative for about thirty to forty years), far from Government holding out any inducements to encourage them in this respect, the growing of timber is hampered with various restrictions that might easily be remedied by legislation. Yet the Houses of Parliament, the two great representative bodies of landowners in the United Kingdom, have never thought it worth while to compel Government, as they might do any time they liked, to give some sort of State-aid, or to relieve timber-growing of any of the financial disabilities under which this branch of rural economy labours, and which often make all the difference between a profit and a loss with so bulky and heavy a crop as timber.

Without either direct State-assistance or, at any rate, substantial encouragement from the State, however, it is hardly possible that private landowners, as a body, will ever be in a proper position for either planting extensively, or for managing extensive plantations on purely business principles in the manner most conducive to the ultimate national-economic welfare of the country with regard to future supplies of home-grown

timber. And certainly, if there be any national duty to perform in this respect, it is the duty of the State, and not of the private landowners. The State is the only landowner that never dies, nor is called upon to pay estate and succession duty, and it is the only landowner that can make large investments without being compelled to desire quick returns in the shape of income; hence the State is the only landowner that can be sure of remaining free from the temptation to thin timber-crops at an early age and to a great extent—or, in short, that can afford to grow the best classes of timber upon rational principles. Hence, too, the State is the only possible landowner that can be reasonably expected to create large compact blocks of woodlands to be formed and managed on business principles, with the twofold object of providing timber in the future, and of fostering and encouraging rural and wood-consuming industries.

3. *Can we learn anything of practical use to us from what has been done in foreign countries about Planting Waste Lands for Profit?*—We may with advantage consider briefly what has been and is being done in Italy, France, Prussia, and Denmark, but it is especially the operations in the last-named two countries that will be of most practical use to us, as the climatic conditions there approximate much more closely to our own than do those of S.W. and S. Europe.

In Italy the forestry question is much the same as in Britain in its nature, though not in anything like so extensive a degree commercially. The woodlands still left are insufficient to meet the national requirements in wood. In 1902 imports were valued at about £2,500,000, while large quantities of charcoal have also to be imported. Consequently, endeavours are being made to induce Government to undertake afforestation and planting, and to encourage private planting by placing an import duty on wood and charcoal.

In France, too, the $23\frac{1}{3}$ million acres of woods (17·7 per cent. of the whole country) are no longer able to provide for the national requirements in timber, so that about $1\frac{1}{4}$ million tons, valued at over £3,000,000, are annually imported, although she annually exports about 360,000 tons weight of small pit-wood and poles, about six-sevenths of which come to Britain. The reckless destruction of woodlands after the Revolution in 1789 produced such disastrous effects in the Alpine districts that laws were passed in 1860 and 1864 with reference to the correction of the watercourses and the planting of the mountain-slopes. From 1861 to 1877 about 235,000 acres were thus dealt with, at a cost of £570,000, and the effects were so favourable that in 1878 a further plan was prepared for the *reboisement* of over 1,880,000 acres within the next 60 to 80 years, at a cost of £2,880,000 for acquiring land in the Alps, Pyrenees, and Cevennes, and of £6,000,000 for reclaiming and planting it. The rules about expropriation of the land required proving drastic, an amendment was passed in 1882 providing £2,500,000 for purchase and *reboisement*. Altogether, some 416,500 acres have been reclaimed, and a scheme has been approved for continuing work at an estimated total cost of about £8,000,000. The greatest national work of this sort in France has been on the barren *Landes* or sand-dunes near Bordeaux, which has already resulted in the planting, with the maritime or cluster pine (*Pinus Pinaster*), of 157,813 acres by the Department of Woods and Waters, the frontage of which forms a protection along 277 miles of the coast-line. The forests that have thus been raised on the dunes of Gascony are now mature and in process of natural regeneration. The practical effect of this work has been that the *Landes* are now one of the best-wooded parts of France, that the climate and the health of the people have become greatly improved, and that these once barren districts have a large and increasing trade in timber and turpentine.

Steps are also being taken to ameliorate the condition of poor grazing-lands in the Pyrenees, where about 1,675,000 acres offer scope for improvement. On the plateau of Lannemezan, a wind-swept waste of 12,500 acres, wind-breaks or shelter-belts are being planted in belts about 35 to 50 feet in breadth, which cross each other at right angles and enclose square blocks of about 16 acres each. When these shelter-belts grow up sufficiently, it is intended that the interior 16-acre blocks thus protected shall be utilised either for agriculture, or pasture, or planting, according to the nature of the soil. In addition to Government work in both of the above directions, however, the forestry question in the south-west of France, from Bordeaux to Carcassonne, has, during the last three or four years, begun to attract much general attention, and (according to the semi-official *Revue des Eaux et Forêts*) "a serious movement is taking shape and is growing in strength from day to day in favour of the conservation of the actual forest area, and of replanting on a

larger scale than at present." The Budget for 1904 included £52,560 for the improvement and upkeep of forests, dunes, and water-courses, and £140,000 for the purchase and re-plantation of waste land for national-economic and protective purposes, in accordance with the law passed on April 4th, 1882, while the budget for 1905 included sums of £50,800 and £135,000 respectively.

In Germany, likewise, the commercial and industrial expansion during the last 30 years has, notwithstanding her large forest area ($34\frac{3}{4}$ million acres), led to the Empire being unable to supply her growing necessities for timber, and she has already to import over $4\frac{1}{2}$ million tons of wood annually, valued at about £15,000,000. Hence, every convenient opportunity is grasped to convert waste land into timber-plantations, and this has, of course, been more particularly the case in Prussia, where the purchase and planting of waste lands by the State has been steadily carried on for more than the last 30 years.

"In Prussia, after about 20,000 acres had already been planted in the Eifel district between 1854 and 1861, an Act of 1871 provided for an ordinary budget allotment of over £50,000 a-year for the purchase and planting of waste lands, and since 1895 this has been raised to £100,000, whereby much has been done each year to improve land-cultivation, especially among the moors and bogs on the Ems and Weser, in the Lüneburger Heide, and in Holstein. The Prussian Forest Department between 1867 and 1892 acquired 329,850 acres at a cost of about £1,125,000, besides granting substantial bounties for planting by private landowners, and giving in one year (1893) about 32,000,000 plants to owners of woodlands. These endeavours on behalf of the State are further assisted by the provincial administrations, communes, and corporations, as well as by large landowners. Thus the woodlands under the Church Lands Department in Hanover have been increased by nearly 14,700 acres in the last thirty years, and those of the Province of Hanover by about 19,600 acres during the last eight years."*

From 1883 onwards, when 34,500 acres of waste land were in hand, large tracts have been bought *en bloc*, and after the sale and exchange of parts suitable for agriculture or pasture, the plantable portions fit for forming large compact woodlands aggregate other 223,300 acres, of which 192,450 acres have now already been planted. The area annually taken in hand has varied from 5,840 acres (1889) to 12,200 acres (1897), and has amounted to 9,140 acres on the average, while the beating up of blanks has extended altogether to 61,100 acres, or 3,060 acres a year on the average, and just under one-third of the area of one year's new planting. About 68,780 acres of "State acquired" waste land remain in hand still (1905) for planting.

Simultaneously with this State-planting, plantations (mainly of Scots pine and spruce) are also being made on a smaller scale by private associations, such as the Society for Moorland Cultivation in Schleswig-Holstein. The objects of this Society are the amelioration of the province by replanting waste lands and improving agriculture. It can merely work on a small scale, as its funds are only about £950 a year (of which the State, the province, and the Agricultural Chamber respectively contribute £275, £200, and £50); but it does very useful work in providing the assistance of a head forester, in making advances for buying plants, and in giving prizes for successful planting.

Great difficulties have to be contended with. The soil is poor, and often impervious from moor-pan, while climatic conditions are unfavourable. The spruce seems specially suitable for planting, as, owing to the dampness of the air, it here grows fairly wel even on poor sandy soil. Deep soil-preparation is necessary where there is moor-pan, and is beneficia where there is no pan; because, though it looks loose and porous, the sand is very fine-grained, and is all the better for being thoroughly broken up and aerated. Hence trenching in strips, with plough or spade, is preferable to pit planting. Subsoil-ploughing with a woodland plough and four horses costs from 20s. to 28s. an acre, while spade-work is dearer, and costs about $\frac{1}{4}$d. per running yard. Marshy spots have, of course, to be drained. Where the moor-pan layer is not bad, the land can, with great advantage, be enriched with marl and artificial manure, and used first for rye, and buckwheat, and sheep-grazing before being planted. But where this cannot be done, then either the whole area must be steam-ploughed, or else trenches and mounds must be formed, the former costing about 32s. to 48s., and the latter 80s. to 120s. per acre.

Protection against storms and blasting sea-winds is of the greatest importance. In exposed situations the spruce plantations are mixed with silver fir, white and Menzies spruce, and pines. And as a protection against fire, the outer roadways are kept free of inflammable matter, the rides between compartments are ploughed and planted, wherever possible, with oak, birch, alder, silver and grey poplar, mountain ash, and larch.

Plants and planting cost about 52s. an acre, and beating up blanks averages about 12s. an acre; but thus improved and stocked, the value of the woodland area is estimated at about £6 an acre. The price at which the waste land can be purchased in its unimproved condition is unfortunately not stated.

In Denmark, similar work on a larger scale has been undertaken by the Moorland Society continuously since its foundation in 1866, with the primary object of bringiug the moors of Jutland into

* Weber, in "Lorey's "Handbuch der Forstwissenschaft," 1903, vol. i., p. 69.

cultivation by drainage, planting, and road-making. Its membership is now 4,712, and it employs ten foresters and thirteen assistant foresters for the supervision and carrying out of its forestry operations, one officer and seven assistants for moorland and meadow cultivation, and one irrigation-engineer and two assistants for its canals, while the whole organisation is under the direction of a head-forester in Aarhus. The woodlands owned by the society extend to 13,800 acres, while the total woodland area coming under its agency is about 137,500 acres. Besides this, there are three centres of moorland and meadow cultivation, with about 2,750 acres of high and low peat-bogs, 185 acres of irrigated meadows, and 70 acres of arable land. The State provides free transport by railway for the marl and lime needed, and in 1902-03 gave a subsidy of £17,000 towards the administration and the work of the society on its own and other properties, of which £3,850 were spent on the society's own plantations, and £5,665 on those of private owners. Altogether more than 100 canalisations have been carried out, and more than 20,000 acres of waste land have been converted into meadows; while, merely in order to provide sufficient marl for the meadows, three tramway-lines have been constructed having a total length of 37½ miles.

Planting is, however, the chief work of the Society, and up to the end of 1901 it had made 1,449 plantations, covering 135,600 acres. When planting is desired by a private landowner a plan of operations is first drawn up, and if the proprietor is willing to subject such areas to the provisions of the Forest Conservancy Law, the Society obtains a State grant towards the cost of planting. As a rule the planting is a mixture of two rows of spruce and one row of mountain pine; but previous to planting the soil is well prepared for some years in advance.

A great deal of planting also takes place for providing shelter from wind to farmhouses, fields, and meadows. About 50 planting-unions, with 25,000 members, have been formed for this special purpose; and the State subsidy to the Moorland Society on behalf of these small unions amounts to £3,850. Further, the Society publishes a journal of its own, and arranges for the collection and exhibition of forest produce, moorland implements, &c. The Society has a wide field still open for its work, as more than 750,000 acres of waste land await improvement and cultivation.

Though necessarily brief, the above notes may suffice to indicate that the action of foreign countries seems worthy of imitation by our own Government, even although this has never been run on such paternal lines as obtain on the Continent. The first and the easiest step that might well be taken in this direction is to obtain and publish complete information concerning—(1) what has been done, (2) what is being done, and (3) what is about to be undertaken in future, in the way of planting of wind-swept waste lands in Denmark and Prussia, the portions of Continental Europe where climatic conditions most closely resemble those obtaining throughout the United Kingdom.

4. *What can the Government be reasonably asked to do in the way of legislative amendments and administrative improvements so as to provide efficient machinery for the acquisition and planting of Waste Land by the State, and the encouragement of Planting by Private Landowners?*—State-planting and State-assistance to private planters (which would logically imply the right to exercise a certain amount of supervision and control) are really two separate questions each worthy of individual attention if space and time permitted. But they may conveniently be both combined, because efficient departmental administration suitable for dealing with either case can easily at the same time be applied to the other. And certainly, if any national effort worthy of the name is to be made in either or both of the above directions, steps must first of all be taken to provide proper departmental machinery, because such does not at present exist. The simplest, most efficient, and most economical way of doing this would be (1) to further amend the Board of Agriculture Acts of 1899 and 1903, so as to constitute a Board of Agriculture, Fisheries, and Forestry, with a special Forestry branch under the direction of an assistant secretary, and (2) to abolish the Commission of Woods, Forests, and Land Revenues of the Crown, by incorporating it into, and distributing its work between, the Board of Agriculture, Fisheries, and Forestry and the Board of Works and Public Buildings (which was constituted in 1832 to perform certain duties previously belonging to the Office of Woods and Forests).

At the first glance this may seem quite an unnecessary proposal, but examination will show it to be merely a move in the direction of efficiency and economy, and not a difficult matter to accomplish. The property vested in the Commissioners of Woods, Forests, and Land Revenues of the Crown consists of (1) woodlands and other portions of the ancient royal forests, and the minerals within the same, (2) agricultural estates, and (3) freehold house-property in London. Of these, (1) and (2) can be most efficiently and economically administered by a Board of Agriculture, Fisheries, and Forestry, because State-planting should certainly begin with and include the waste land in the ancient

forests, while (3) can also be just as efficiently and probably at the same time perhaps a little more economically administered by the Board of Works and Public Buildings. Each of these two Boards is directly responsible to Parliament through a Minister, whereas the Commissioners of Woods and Forests are not directly represented in Parliament. Again, the Select (Parliamentary) Committee on Forestry, in the report of 1887, found itself compelled to call attention to the "unskilled management" of the Crown woodlands generally, and another Select Committee was appointed to inquire into the administration of this Department. Although this Committee of 1889 reported, in 1890, that it found the administration by the Commissioners of Woods and Forests satisfactory, this could no longer be the case if there is to be any great national movement towards planting waste lands for future profit, because the Crown woods, forests, and waste lands must be practically subject to the same management and control as any and all other plantations that may be formed by the State or with State-aid. And already the Board of Agriculture performs the functions of the Land Commissioners for England, and administers the Acts relating to the improvement of properties by limited owners (Settled Land Act, &c.; see below); hence common-sense, efficiency, and economy would all demand that the Crown woods and wastes should be treated in the same manner as State-acquired waste lands and State-aided plantations on land owned by municipalities, corporations, or private persons.

With regard to Ireland, where special attention has long been urgently called for, provisions have been made under the Irish Land Act, 1903, for the acquisition of waste lands by the State with a view to planting, though this only applies to any estate "in the main agricultural or pastoral" (sect. 10). The authority for this is contained in sect. 4 as follows:—

"(1) In the case of the sale of an estate, advances under the Land Purchase Acts may be made for the purchase, by any trustees approved of by the Land Commission, of any parcel of the estate to be held subject to the provisions of this Act, for . . . the planting of trees, or the preservation of . . . woods or plantations . . . (2) An advance in pursuance of this section may be of such amount as the Lord Lieutenant may sanction."

And under sect. 12:—

"(1) The Land Commission may take such steps and execute, or cause to be executed, such works as may appear expedient for the benefit or improvement of estates or untenanted land purchased or proposed to be purchased under this Act . . ."

If such a forestry branch be created under the President of the Board of Agriculture, one of its first obvious duties would be to arrange for the selection and enrolment, county by county, of all tracts of waste land, poor pasturage, or land out of cultivation, which may appear to be more suitable for planting than for any other form of utilisation. This work could perhaps be most expeditiously performed by a committee consisting of three members, one of whom would be nominated by the County Council, one by the larger landowners, and one by the Board. This would very soon furnish tolerably complete data regarding

(1) The extent and the actual rental and capital value of all the poor land fit for planting;
(2) The suitability of soil and climate;
(3) The prospects of disposing of timber favourably in the future;
(4) And any and all other information likely to be of use with regard to planting, either by the State or by private persons.

These records should be complete for each county, so that each case could be considered on its own particular merits.

The next step required to be taken, after providing efficient departmental administration, is to provide funds (to whatever extent may seem necessary) for acquiring and planting land, and for assisting private owners to plant. It is not likely that there would be any difficulty in passing an Act to provide for the reclamation and planting of waste and other lands out of cultivation, and in raising the money for a "Waste Land Planting Fund" by means of guaranteed $2\frac{3}{4}$ per cent. stock, much in the same way as is laid down for the Irish Land Purchase Fund in sects. 28 to 36 of the Irish Land Act, 1903, the management of the fund being vested in the Land Commission forming part of the duties of the Board of Agriculture, Fisheries, and Forestry. From this fund all loans granted to private landowners for planting (under the Settled Land Act, 1882, or other Acts; see below) could be issued at the rate of 3 per cent. without any loss to the nation as lender and with much advantage to the landowners as borrowers.

Under the *Local Government (County Council) Act*, 1888, sect. 65 gives "Power to acquire lands," while sects. 79 to 82 provide for the appointment of a Committee with power to acquire land and make regulations for the proceedings of Committees. But new legislation in the form of a Bill *for the Improvement of Woods and Plantations and the Planting of*

Waste Land will, of course, be necessary to obtain any satisfactory enactment regarding the extensive acquisition of waste land for planting, and the formation of a "Waste Land Planting Fund" and of a Forestry branch of the Board of Agriculture and Fisheries.

Among the existing disabilities and discouragements to planting which require to be removed before there can be any reasonable hope of inducing municipal, corporate, or private landowners to plant extensively, the following matters may be specified as those which ought to be dealt with either by legislation, or else by improved administration, or by both of these means :—

(1) Want of funds.
(2) Valuation of woodlands and plantations for estate and succession duties, and for local rates.
(3) Risk of damage by rabbits.
(4) Higher railway charges than for foreign timber.
(5) Risk of fire caused by railway-engine sparks.

1. *Want of funds* has always been the chief obstacle to planting, and monetary assistance is the form of State-aid now most required by corporate bodies and private landowners desirous of planting for profit.

Under the Land Improvement Act, 1864, the improvement of land by planting was confined (Sect. 9) solely to "Planting for Shelter;" and owners of land were only able, with the sanction of the Commissioners for the execution of the Act, to charge their estates for the planting of woods and trees in cases where this was for the express purpose of providing shelter. By the Improvement of Land (Scotland) Act, 1893, this limitation was removed so far as Scotland was concerned, and similar assistance has been provided for England under the Settled Land Act, 1882, so that applications may now be made to the Board of Agriculture for sanction to charge estates with the cost of planting, whether for shelter or otherwise. And, subsequently, the Improvement of Land Act, 1899, amended the Improvement of Land Act, 1864 (which applied to all the United Kingdom), and extended to Scotland so much of the Settled Land Act as related to improvements, so that money borrowed may now be repaid by a rent-charge extending to a period not exceeding forty years*; but as even quick-growing conifer crops may often, under good management, take longer than that to mature, this period might well be extended to forty-five or fifty years.

With regard to entailed estates provision is made under the Settled Land Act, 1882, for the capital being loaned by trustees for improvements such as planting. Sect. 21 authorises that "Capital money arising under this Act" may be given "(iii.) In payment for any improvement authorised by this Act," and Sects. 25 to 30, dealing with the improvement of settled estates, give full authority for the spending of such capital on all works of drainage, enclosure, clearing, trenching, planting, road-making, &c., necessary to carry out planting operations in a complete manner. But Sects. 26 and 28 distinctly direct that such schemes of improvement shall be based upon some sort of definite working-plan to be properly adhered to, so that the plantations may be treated on business principles.

"Sect. 26.—(1) Where the tenant for life is desirous that capital money arising under this Act shall be applied in or towards payment for an improvement authorised by this Act, he may submit for approval to the trustees of the settlement, or to the Court, as the case may require, a scheme for the execution of the improvement, showing the proposed expenditure thereon.

"(2) Where the capital money to be expended is in the hands of trustees, then, after a scheme is approved by them, the trustees may apply that money in or towards payment for the whole or part of any work or operation comprised in the improvement, on—

"(i.) A certificate of the Land Commissioners certifying that the work or operation, or some specified part thereof, has been properly executed, and what amount is properly payable by the trustees in respect thereof, which certificate shall be conclusive in favour of the trustee as an authority and discharge for any payment made by them in pursuance thereof; or on

"(ii.) A like certificate of a competent engineer or able practical surveyor nominated by the trustees and approved by the Commissioners

* The money expended on improvements and all expenses may be charged in one sum on the estate. The loans under the Scottish Draining and Improvement Company's special Act are repayable by instalments during any period not exceeding twenty-five years; and the rent-charge, to repay capital and interest within that period, is at present £5 19s. 1d. per cent. per annum, payable half-yearly, for advances of £300 and upwards, and £6 14s. for advances under £300. Under the Improvement of Lands Act, 1899, the Board of Agriculture may extend the period of charge to forty years, in which case the annual rent-charge for sums of £300 and upwards is at present £4 11s. 6d. per cent. per annum, payable half-yearly, and £5 8s. 3d. for advances under £300.

or by the Court, which certificate shall be conclusive as aforesaid ; or on

"(iii.) An order of the Court directing or authorising the trustees to so apply a specified portion of the capital money. . . .

"Sect. 28.—(1) The tenant for life and each of his successors in title having, under the settlement, a limited estate or interest only in the settled land, shall during such period, if any, as the Land Commissioners by certificate in any case prescribe, maintain and repair, at his own expense, every improvement executed under the foregoing provisions of this Act. . . .

"(2) The tenant for life or any of his successors as aforesaid, shall not cut down or knowingly permit to be cut down, except in proper thinning, any trees planted as an improvement under the foregoing provisions of this Act. . . .

"Sect. 38.—(1) Where a tenant for life is impeachable for waste in respect of timber, and there is on the settled land timber ripe and fit for cutting, the tenant for life, on obtaining the consent of the trustee of the settlement or an order of the Court, may cut and sell that timber, or any part thereof.

(2) Three-fourth parts of the net proceeds of the sale shall be set aside as and be capital money arising under this Act, and the other fourth part shall go as rents and profits.

If a Waste Land Planting Fund were created by enactment (as already suggested above), it would surely be a very simple matter for the Land Commission to grant advances for planting at 3 per cent., upon mortgage of the lands, plus the plantations, and also to arrange for the amortisation of the debt and the release of the mortage either (*a*) by means of annual payments extending over the next 30, 35, 40, 45, or 50 years, or else (*b*) by refund of the capital sum and of compound interest at 3 per cent. payable on the timber-crops being certified to be of marketable age or mature and ripe for felling and selling. Of course, it would be a *sine quâ non*, that such advances would only be made on working-plans or schemes for planting and future management duly approved by the forestry branch of the Board of Agriculture, &c., and provision would have to be made for exercising reasonable supervision to ascertain that the objects of the advance were being properly realised ; but these would be mere matters of detail in a well-managed department.

2. *Valuation of Woodlands and Plantations for Estate and Succession Duties and for Local Rates.*—The valuations made in respect of woodlands and plantations under the Succession Duty Act, 1853, the Finance Act, 1894 (for estate duty), and the Rating Act, 1874, are so complex, so illogical, so variable, and sometimes so unjust in their incidence as to call urgently for simplification and amendment. These provisions in question are as follows :—

Succession Duty Act, 1853 (Sect. 23).—"Where timber, trees, or wood, not being coppice of underwood, shall be comprised in any succession, the successor shall be chargeable with duty upon his interest in the net monies, after deducting all necessary outgoings for the year, which shall from time to time be received from any sales of such timber, trees, or wood, and shall account for and pay the same yearly ; provided that no duty shall be payable on the net monies received from the sale of timber, trees, or wood, in any one year unless such net monies shall exceed the sum of ten pounds ; provided that if the successor shall be desirous of commuting the duty, and shall deliver to the Commissioners an estimate of the net monies obtainable by him from the sale of such timber, trees, or wood as may, in a prudent course of management of the property, be felled by such successor during his life, the Commissioners, if satisfied with such estimate, shall accept the same and assess the duty accordingly."

To satisfy the above requirements the custom in England has generally been to value all the timber and other wood, and to take 3 per cent. of this as a fair annual return under good management. This income is then treated as an annuity, and succession duty has to be paid upon it on a scale laid down in tables annexed to the Act. Thus, if the life-tenant were 40 years of age on entering into succession, and the annual income from the woods were estimated at £500 a year, the annuity would be considered as having a capital value of £7,437½ assessable to duty (and not as £500 ÷ 0·03 = £16,666).

Finance Act, 1894, Sect. 7 (5).—"The principal value of any property shall be estimated to be the price at which, in the opinion of the Commissioners, such property would fetch if sold in the open market at the time of the death of the deceased . . .

"(8) Subject to the provisions of this Act, the value of any property for the purpose of estate duty shall be ascertained by the Commissioners in such manner and by such means as they think fit . . ."

In Scots law, under the Valuation of Lands Act, 1854, s. 6, in estimating the yearly value of lands and heritages, the same shall be taken to be the rent at which, one year with another, they might in their actual state be reasonably expected to let from year to year. Where they consist of woods, copse, or underwood, the yearly value shall be taken to be the rent at which they might in their natural state be reasonably expected to let from year to year as pasture or grazing lands (Bell's "Dictionary and Digest of the Law of Scotland," 1890, p. 1106).

Rating Act, 1874, sect. 4.—"The gross and rateable value of any land used as a plantation, or a

wood, or for the growth of saleable underwood, shall be estimated as follows:—

"(*a*) If the land is used only for a plantation or a wood, the value shall be estimated as if the land instead of being a plantation or a wood were let and occupied in its natural and unimproved state.

"(*b*) If the land is used for the growth of saleable underwood, the value shall be estimated as if the land be let for that purpose.

"(*c*) If the land is used both for a plantation or a wood and for the growth of saleable underwood, the value shall be estimated either as if the land were used for a plantation or a wood, or as if the land were used only for the growth of the saleable underwood growing thereon, as the Assessment Committee may determine."

Now, considering the desirability there is of encouraging the planting of poor land and the prudent management (for the national welfare) of timber-crops, which take long to mature, are exposed to many dangers from storms, insects, fungous diseases, fires, &c., and offer many a temptation to heavy thinning and premature clearance in the interests of life-tenants of estates, it seems very desirable that a short Act should be passed providing that in all cases in which plantations, woods, or coppices are managed in accordance with the provisions of a working-plan approved by the Board of Agriculture, &c., their assessment to rates shall be simply the rental value of the land in its natural and unimproved condition, and their valuation for succession duty and estate duty shall simply be such same rental value capitalised at 25 years purchase (4 per cent.). Of course this merely assesses and values the land, and not the timber growing on it; but this is a very slight concession for the Treasury to make in view of the national duty of encouraging the home-growth of timber to the largest possible extent. And further, with regard to payment of rates, the option might be given of either paying them annually or else permitting them to accumulate at compound interest at 3 per cent. till the plantations or woods are certified to be mature or marketable.

3. *Risk of damage by rabbits* is a very serious matter as regards young plantations and the natural regeneration of mature timber-crops,—so much so, in fact, as often to imperil the chance of plantations proving profitable. No one can possibly assess the total amount of loss annually occasioned by rabbits to agricultural crops, grass lands, young plantations, and coppices throughout the United Kingdom; but I venture to assert that it runs not merely into hundreds of thousands of pounds, but may possibly far exceed one million pounds sterling.

In the conditions attached to gun-licenses it is expressly said that rabbits are not included among vermin; whereas it ought to be specified that rabbits are vermin, except in warrens expressly formed for their preservation, and properly enclosed with rabbit-proof wire-fencing to prevent their exit.

If national encouragement is to be given to extensive planting, the rabbit question is really a very serious one. Except in properly enclosed warrens everyone should have the right to kill and take rabbits; there should no longer be private property in rabbits (outside of warrens); and the warren-owner and his tenant-occupier should conjointly be liable to be proceeded against in the County Court for any damage done to fields, pastures, woods or plantations by rabbits which have escaped out of any such wire-fenced warren.

4. *Higher railway charges* are made for the transport of home-grown timber than for the through booking of foreign timber. Where only comparatively small quantities of timber are in question, it is quite reasonable that there should be some difference; but it should not be difficult to arrange (by legislation, if necessary) that large quantities of timber (above a certain minimum) shall be conveyed at the same rate as is charged for foreign timber of a similar character. These preferential through charges on imported timber and the system of measurement used by the railway companies handicap home-grown timber heavily; and all the loss in its local value must ultimately fall on the landowner, because the prices paid by wood-merchants are based on what the timber will cost them delivered at the mill-yard or other destination.

5. *The risk of fire caused by sparks from railway engines* is a serious matter on dry land planted with pines and firs, which has been partly provided for in the Railway Fires Act, 1905, that comes into force on January 1, 1908. But the claim for damage is, by Sect. 1 (3), limited to £100 in the case of any action for damage, and this seems inadequate, while the provisions made for the prevention of fire might easily be rendered much more effective by some such additional section as the following:—

For the purpose of preventing or diminishing the risk of fire in a plantation, wood, orchard, or nursery, the owner may submit to the Board of Agriculture a proposal for the fire-protection of the same by means of reasonably necessary precautions, together

with an estimate of the cost thereof, and on this being approved and sanctioned the Board may pass orders for the payment by the railway company, on the completion of the work, of a reasonable share of the actual cost, not exceeding a maximum of one-half of the estimate sanctioned or of one-half of the actual expenditure incurred, whichever may be the less in amount.

5. *How should Waste Land be Planted for Profit?*—Certainly, in as large and compact blocks as may be possible, because timber-crops grow better in large masses than in small woods; there is better shelter from wind, and a smaller proportion of wind-swept fringe; the circulation of soil-moisture is more equable; there is economy in the first cost of outer boundaries (if required) and fencing, and annually in supervision, for one forester can far more easily supervise four or five compact blocks, aggregating 2,000 to 3,000 acres, than he can exercise proper supervision over half of that acreage if scattered about in smaller blocks of 100 or 150 acres. And, of course, those tracts should first be dealt with which are within fairly easy reach of places likely to prove good centres for the future sale of wood.

Considering the present condition and the future prospects of the timber-market, there can be very little doubt that in plantations made for profit the main crops will be formed for the most part of coniferous trees. Our soil and climate are well suited for their growth; they can be grown on poorer land and attain marketable dimensions sooner than hardwood crops, which means that they can be grown without locking up so much capital in timber; they have a readier sale (especially as small stuff for pit-wood), and are, on the whole, more profitable than the hardwoods or softwoods grown on poorer classes of land. Indeed, conifers are often the only kinds of trees that could thrive on much of our poor land, and they are the kind of wood we are most in want of, as nearly nine-tenths of our timber-imports are of this description.

So far as regards the chief kinds of coniferous trees likely to prove profitable, one can merely generalise by saying that on dry sandy land, Scots pine; on better, well-drained, loamier land, Weymouth pine, Douglas fir, and silver fir; on moister land, spruce; and on decidedly limy soil, Weymouth pine and Austrian pine will often likely be most suitable for forming the main crop; that timber-crops are usually best when formed of mixtures of different trees grown in patches; that a sprinkling of larch generally proves profitable on all land having good natural drainage; and that on the better classes of soil an admixture of hardwoods and softwoods is often also desirable. On suitable soil and situation, the largest and often by far the most profitable crops are produced by Weymouth pine, Douglas fir, larch, white willow, and black poplars.

The bulk of the waste lands suitable for planting consist of poor deteriorated rough mountain pasture and moorland peat-bogs, and the former are usually the more favourable for operations. Except to the comparatively small extent to which the peat-bogs have been cut away, there is not (even with previous drainage) much chance of planting with profit on land of this class; because, even with expensive drainage and ditching deep enough to break through the stiff layer of clay or the thin impervious moorpan, upon the presence of which the swampy moorland condition depends, timber-crops (even of Scots pine) do not thrive unless their roots can soon get into direct contact with the mineral soil. Hence, this class of land, usually far from any favourable market for thinnings and mature timber, is not that deserving the first attention. Land overgrown with furze or broom should produce good timber-crops of mixed conifiers, for it is usually loamy and naturally well-drained. Bracken-covered wastes are poorer in quality, while heather-grown land is often either very dry or very moist, and is generally so poor and deteriorated as to be better suited for pine than for more exacting kinds of trees.

The better class of waste land is covered with furze or broom, or with a mixture of furze and bracken, while the poorer stretches of barren mountain-land and the shallow-soiled exposed uplands are generally overgrown with heather (ling) chiefly. The growth of grass is there never strong enough to interfere with planting. In the peat-bogs and their immediate vicinity, bell-heather and the common ling usually overgrow the surface-soil, and it is only the "cut-away" parts of such tracts that can be planted at present with any fair chance of profit. But these are, at the same time, just the parts that can easily be brought under profitable agricultural occupation.

Wherever large blocks of waste land are to be planted, either by the State or by private landowners, the work should not be taken in hand until a simple, clear, and definite working-plan for drainage, shelter-belts and planting has been well considered and adopted for the next 10, 15, or 20 years or more, because

the most essential conditions for success are (1) careful, methodical, economical, and far-seeing management, (2) natural or artificial shelter from strong winds, and (3) satisfactory natural or artificial drainage. Such a working-plan can be modified at any time if circumstances make amendment desirable; but there ought from the very beginning to be systematic method and regularity. It is not sufficient merely to arrange for planting the kinds of trees likely to thrive on the given soil and situation; one must also look ahead to the time when these plantations will become mature, and must consider how the timber can then be cleared without running needless risk of damage from wind and from insects. This looking far ahead seems usually to have been hitherto quite neglected when making large plantations in Great Britain and Ireland.

On open and wind-swept lands large compact areas will seldom be plantable with profit without artificial shelter of some sort being provided to a greater or less extent by planting shelter-belts in advance; and on extensive stretches of hill-slopes wind-breaks of this sort are an absolute necessity to give young plantations any fair chance of thriving.

When it has been decided to plant any extensive area of waste land, its boundaries will have to be fenced and a network of main and subsidiary roads projected and marked off in the manner most convenient for the future transport of thinnings and timber—though there is no necessity for metalling the roads in the meantime—and this can easily be done from the contour-lines on the Ordnance Survey maps.

The road-system should be so planned that the whole area can be divided into main sections of about 440 yards square (40 acres), subdivided, if convenient, by narrower roads (220 yards apart) into 10-acre compartments, and having one side at right angles to the most dangerous prevailing wind (generally the S.W.). Shelter-belts should then be formed about 20 to 30 yards wide along the windward edge of each main section, if the planting of the whole area is intended to be accomplished within say 10 years,—or along the windward edge of each alternate section, if it be desired to extend the planting over about 20 years,—and the intervening stretch can be marked off as the areas to be successively planted during each of the next 10 or 20 years. The planting of such shelter-belts with quick-growing thickly-foliaged pines and firs should precede the planting of the rest of the area by at least five years, so as to allow the belts to establish themselves and thus become able to afford substantial protection against cutting winds to the younger strips of plantation successively formed year by year to the leeward of them.

Moorland peat-bogs are generally water-logged and rest on an impervious clay subsoil. Such cold land only produces stunted pine, birch, aspen, willow, and alder, in its unreclaimed state, or merely bears an unproductive soil-covering of heath, heather, and rough grasses and bog-plants. Even after drainage it usually remains dull and inert at first, though it often forms good woodland soil on becoming more earthy. Thorough drainage of such land by deep open trenches is necessary before planting can have any chance of succeeding, and after the drains are opened the land should lie fallow from twelve to eighteen months.

Unless drainage can be done cheaply and the mineral soil can be soon reached, there is small chance of peat-bogs being plantable with profit, as even well-drained hags of dripping peat will only grow Scots pine intermixed with birch, aspen, and also spruce in sheltered parts. On the better classes of bog and peat land white willow and common and Canadian black poplars sometimes do well, and may then prove the most profitable trees that can there be grown. Sometimes oak and ash can thrive on well-drained mossy soil resting upon clay; but such land is usually only suitable for conifers and softwoods.

On hillsides from 500 to 1,000 ft. in elevation planting may sometimes be more profitable than arable cultivation or pasturage. Their soil is mostly light, fairly good, and well suited for larch, Douglas fir, and Weymouth pine, the quickest-growing and most profitable conifers, as also for other pines, spruce, and silver fir, while at lower positions the soil is often good enough both for hardwoods and softwoods.

6. *What will be the Probable Cost of Planting Waste Land, and what are the Prospective Returns from the Thinnings and the Mature Timber-Crops?*—Planting now costs much more than it used to. From 30s. to 40s. per acre, has now, in many cases, risen to from £4 to £6, and even £6 to £8 per acre. Plants and labour now cost about twice as much as formerly; and rabbits are also so universal and destructive that the necessary wire-netting against this pest may add considerably to the cost of planting, and may in many cases swallow up any profit otherwise obtainable from growing timber. Conifers are usually

cheaper to plant than broad-leaved trees. If the land is light, and requires little or no draining or special clearing, the cost of notching at 3 ft. by 3 ft. (4,840 per acre) *i.e.*, the cost of plants and planting only, exclusive of draining, clearing weeds, fencing, rabbit-wiring, or filling blanks, would be about £3 per acre; and this may be taken as about the minimum cost at which it is now possible to plant, if the plants have to be purchased from a nursery.

But it will seldom be found possible to plant at anything like so cheap a rate. The land will probably often need drainage, clearance of heather and furze, trenching, or other soil-preparation, which all mean additional cost; and a stronger and dearer class of plant, with a more expensive method of planting, will usually also be necessary. Taking the general average of unimproved waste land suitable for planting, an estimate of £6 to £7 per acre (including beating up blanks for first two years, but not including rabbit-wiring) is not likely to be far wrong for the planting of conifers, mostly of Scots pine, spruce, larch, Douglas fir, Weymouth pine, and silver fir in mixed woods, planted in patches, and will also cover the cost of planting hardwoods and softwoods on good land requiring less drainage, but more clearing and soil-preparation.

If a great national scheme of planting were to be adopted, the planting of 3⅓ million acres of waste land (see above, under 1) would probably cost about £6 an acre, exclusive of the cost of acquiring the land and maintaining the woods and plantations. This would mean a total actual outlay of about £20,000,000 (leaving compound interest out of consideration here) which could be spread over the next twenty, thirty, forty, or fifty years.

Considering the long period of time elapsing between the sowing and the reaping of timber-crops, and also the destructive gales that occur every few years, there must always be an element of uncertainty as to the future profit from planting, though actual experience has shown that land unprofitable for arable cultivation or pasture has often yielded good returns under timber. On the other hand, it is a well-known fact that the world's demands for timber are growing annually, while the area of possible production is diminishing yearly, and there is therefore a self-evident probability that timber may have a greatly increased value; but beyond this it is not very safe to go, and it is impossible to make trustworthy actuarial calculations either about thinnings or mature timber. In many of the least-populated parts of the United Kingdom, distant from seaports and railway-lines, there is so little demand for such timber as there is that mature crops are at present unsaleable*, and it would necessarily be a somewhat risky step to take if large plantations were made simply in the hope that conditions would improve by the time the timber-crops were mature. Near coal-mines there is always a demand for pit-wood; but, apart from places within easy communication of these, any great increase in the present woodland area throughout the United Kingdom must, to be profitable, go hand in hand with the encouragement and improvement of existing wood-consuming industries, and the creation and fostering of new ones, before it is possible that any large investment of national capital in this direction is likely to have any fair chance of assuring direct monetary profit. Demand creates supply; but supply does not always create demand, and this is particularly the case with timber. A great impetus would at once be given in this direction if the proposed fiscal changes now under consideration should ultimately again include an import-duty on all sawn or partially converted timber imported from any *foreign* country in any other shape than round logs or rough-hewn squares. Such a change would at once give a great impetus to the sawmill business, and would encourage the growing of wood for profit in a way that has never been done since the import-duty was entirely taken off imported timber in 1866. This, together with facilities for obtaining the loan of the necessary capital on easy but fair terms, would be more likely than anything else to stimulate planting on a large scale; and it would mean an immense addition

* Although our building and mining operations, railways, and many other industries require vast quantities of timber annually, yet there are many parts of the United Kingdom (more particularly in Ireland, the least industrial part of the kingdom) where there are practically no local industries requiring wood as their raw material. For example, most of the larch produced in the south-east of Ireland is shipped to Liverpool or Cardiff for pit-wood, and as its value is regulated solely by the price obtainable at these ports in competition with foreign imports, it often happens that the landowner only gets about 6d. a cubic foot for larch that could easily be disposed of at a 1s. a cubic foot (and often more) in many parts of England and Scotland. For Scots pine and spruce grown along with the larch in Ireland there is often practically no market at all, not even as fuel; and the same may be said about small thinnings below pit-wood size. Without local industries consuming wood, the value of timber *in situ* therefore usually declines proportionately with the distance and the cost of transport from some assured market.

to the amount spent in the transport and milling of timber, in the preparation of cellulose and wood-pulp, and in the creation and fostering of industries dependent on wood as their raw material.

A splendid example of extensive and successful planting on poor waste land is to be found in the conifer plantations made by Earl Fitzwilliam near Rathdrum, Co. Wicklow, during the famine years 1847-49, to provide work for some of the starving peasantry. The land was poor, and only of nominal value for grazing; but the timber-crops, now mature, are worth *in situ* from £50 to over £60 an acre (part was actually sold in 1903 at £63 an acre), while they have at different times given very fair returns from thinnings. The entire removal of timber-duties, in 1866, of course struck a hard blow at this desirable sort of enterprise, and no compensating inducements have yet been offered by Government to encourage landowners to plant.

7. *What would be the National-Economic Effect of Planting Waste Lands Extensively?*—This has partially been indicated in the last paragraph above, but the following comparison of the British timber-imports in 1882 and 1902 can speak for themselves:—

	1882.	1902.
Wood and Timber.	£	£
Hewn	5,200,000	5,400,000
Sawn	10,800,000	17,100,000
Manufactured	300 000	1,400,000
	£16.300.000	£23,900,000
Paper (mostly made of wood-pulp) ..	1,200,000	4,500,000
Paper materials (mostly wood-pulp)	2,000,000	3,300,000
	£3,000,000	£7,800,000
Total ..	£19,500,000	£31,700,000

Now, as our population was 35,241,000 in 1881, and 41,976,000 in 1901, it therefore follows that the imports of timber in the rough have fallen (proportionately to the population), and that the only increase has been in converted timber; and anything that will conduce to furnishing home-grown supplies of timber must also necessarily provide employment in various forms for our own workpeople, and must cause money to be circulated among our own industries in place of being paid to the other countries supplying us with timber. A great national movement in the direction of planting waste lands would therefore tend to gradually provide employment for certain sections of the working-classes; but, to what extent this would be the case, it is impossible to say. It is estimated that the German forests ($34\frac{3}{4}$ million acres) now yield about £22,000,000 a year, of which about £8,000,000 are spent on maintenance and extraction, leaving a net income of about £14,000,000, or over 8s. an acre. And as far back as 1875 it was also estimated that, in addition to all expenditure within the forest limits, the timber, &c., afforded employment to 9 per cent. of all the industrial classes, representing nearly 1-16th of the total population. Such facts as these may well lead thinking people to ask themselves if steps ought not to be taken to secure somewhat similar benefits for our own working-classes and for the country in general; and if so, I do not think the proposals made above (under query 4) can be called unreasonable.

So far as concerns the amount of labour required in woodlands, official statistics show that in the Prussian State forests, now aggregating 7,127,000 acres, 159,283 hands were employed and 10,506,941 days' work were paid for in 1902 (in addition to permanent officials and subordinates). The total amount paid is not mentioned in the summary from which I have this, but the above means the equivalent of permanent employment for about 35,000 hands all the year round, or about one hand for every 185 acres of woodlands. Therefore, $3\frac{1}{3}$ million acres of new plantations in the United Kingdom would be about equivalent to providing new and permanent employment for about 18,000 hands all the year round. It was estimated, in 1892, that the State forests and State-managed forests in Austria, aggregating 2,205,317 acres, provide employment for 18,336 workmen, while members of their families are employed to a total number of 39,060 persons.

For the Prussian State Forests (7,127,000 acres) the budget of 1905-06 estimates a gross income of £4,987,550, an expenditure of £2,489,205, and a net revenue of £2,498,345 (which is £59,205 less than in 1904-05). But this outlay includes an *extraordinary* allotment of £200,000 for acquiring and planting waste land, in addition to the *ordinary* annual allotment of £52,500. The Forest Service (consisting of 1,109 officers and 4,640 subordinates) costs £854,000, while payments for labour in felling and handling the timber and in regenerating the woods amount ot £1,114,164, so that close on £2,000,000 are annually paid for work done in direct connection with those State-woodlands before the timber leaves them as raw material for timber-consuming industries.

For the Bavarian State-forests (2,315,000 acres) the budget of 1905 showed a gross income of £2,082,500 and an expenditure of £914,200, leaving a net revenue of £1,168,300, or over 10s. 1d. per acre. The permanent establishment (consisting of 743 officers and 1,698 subordinates) cost £318,000, £7,765 was allowed for forestry instruction, and £475,150 was spent on work in the forests (of which £337,400 was for the felling and handling of wood, and £72,500 for regenerating the timber-crops, *i.e.*, about £400,000 was distributed among hands employed on daily labour within the woodlands).

These figures speak for themselves as to the undoubted fact that well-managed extensive woodlands add greatly to the wealth of a country in providing employment in the woods and raw material for various industries.

State-planting or State-aided planting would help to provide employment in rural districts in autumn and spring, though it is hardly likely in this way to contribute much towards the solution of the problem of the unemployed; but it would always be at least a step in the right direction.

There can, however, certainly be no question about the national benefits that would be derivable from large woodlands with regard to the maintenance, equalisation, and purification of our domestic water-supplies. And the activity now shewn in different parts of the country in planting the water-catchment areas (*e.g.*, the Corporation works at Vyrnwy, near Liverpool, and at Tala Water, near Edinburgh) gives hope that perhaps some day soon the nation may awaken to a true knowledge of the importance of home-grown timber-supplies to the industrial wealth of a nation, and may then force the Government of the day, *nolens volens*, either to undertake State-planting, or else to give adequate assistance and encouragement to private parties—or to do both of these, which would be far preferable, and would all the sooner ensure the attainment of the objects desired.

DISCUSSION.

Mr. E. Stafford Howard, C.B., in opening the discussion, expressed his regret at the absence of Dr. Nisbet, because it would have been more pleasant to those who had attended if he had heard the discussion. With the object the author had in view in writing the paper all sympathised, and also with a good deal which had been written; but, at the same time, there were certain parts of the paper and suggestions made in it with which he was not able to agree. Dr. Nisbet had said that the State had hitherto done nothing to help in the general planting of the country. That was practically true. At the present time all parties were calling upon the State to help in all sorts of projects, and at the same time they denounced the State for its extravagance. If the State spent money on such an enterprise, it would have carefully to consider the matter before it made any large capital expenditure, to see if there was a reasonable probability of a satisfactory result. He had always held that there had been a great exaggeration in the statements made as to the area of waste land which was capable of being planted, because all moorland and a great deal of other land was characterised as waste land. He received numbers of letters every year from people asking him why all the Crown wastes in Wales could not be profitably planted with trees. The answer was that every acre of Crown wastes was liable to common rights, and was fed over by the sheep belonging to the people in the district, and those common rights would have to be got rid of before anything could be done. Even supposing they were not subject to common rights, a very large area of the Crown wastes was above the 1,000 feet contour, and in the opinion of those best qualified to judge, it was most risky to plant at that altitude. With Dr. Somerville, he had walked over very considerable parts of mountainous Wales, looking for a sufficient area suitable for planting, and as yet they had not been able to find one which met the requirements set out in the paper. He had been for some time looking for a similar property in Scotland. It was said there were thousands of acres of land to spare in Scotland, but the difficulty was, in the first place, to find an area that was suitable, and, in the second place, to find an owner who was willing to sell at a reasonable price. He quite agreed with the author in cutting down the 70,000,000 acres, which it was suggested was the total area of waste land, to about one-fifth, which he thought would probably be a liberal allowance to make. One of the first things to be done before the State could carry out the suggested scheme was to institute such an enquiry as was recommended by the Departmental Committee on Forestry as to the amount of waste land in the several counties of the United Kingdom suitable for planting. He thought the enquiry could be very well carried out by the Board of Agriculture, which already collected a number of agricultural statistics. It might interest the author to know that the Office of Works and Office of Woods were, for a considerable number of years, one office, and they were deliberately divided by the Government of the day more than fifty years ago, because it was found in practice that it was not convenient, from the public point of view, to work them together. The principal business of the Office of Woods, Forests and Lands was the collection from the Crown properties of land revenues, which were paid into the public exchequer. The Office of Works was

an administrative and spending office. It was recommended by the Departmental Committee, of which he was a member, that, if possible, areas should be found, both in this country and in Scotland, which might be used as demonstration forests. There again, the great difficulty was to find an area, as the author suggested, of two or three thousand acres which could be planted and worked economically. He had been hunting for a long time past for a piece of land in one block of 3,000 acres in such a situation that there would be a reasonable prospect of marketing a crop of timber with advantage. He received an offer of a large area in Scotland, but the landowner would not sell it upon any condition, but only let it on lease; and as he did not consider that a satisfactory condition on which to accept land for planting, he declined to have anything to do with it. The few places that might be utilised were the large catchment areas acquired by the corporations of many large towns for the purpose of water supply, and he was glad to know that several of the corporations had taken up the question of planting the areas thus acquired. He quite agreed with Dr. Nisbet that the difficulties he had pointed out could not be ignored. The landowner was in the difficult position, with very few exceptions, of not having the necessary capital to spare, and the esults of the investment were problematical and long leferred. He therefore thought that, unless some assistance and encouragement was given to landowners, not many of them were likely to do much in the way of planting. He should like to see that assistance and encouragement given, because if that were done planting would probably be carried out much more successfully than by the State taking up little blocks here and there and planting in small patches. He heartily agreed with what Dr. Nisbet had said about rabbits. Parliament was quite alive to the evils of rabbits nearly 100 years ago; and in every Act passed in the last century enclosing land on which the Crown could plant, a clause was inserted that no rabbits should be allowed in the forests on any pretence whatever. He regretted to say that in one of the forests, owing, he presumed, to laxity on the part of his department in days gone by, and probably also owing to the sporting tendencies of the tenant to whom the principal house in the forest was let, the underwood was almost totally destroyed by rabbits, in spite of the Act of Parliament. This department did their best to enforce the Act now, but a rabbit was not more obliging in the matter of obeying Acts of Parliament than men were. To quote the reply of an old keeper, it required "time, tools and talent" to get rid of rabbits, and not everybody had those special qualifications.

Sir Dietrich Brandis, K.C.I.E., F.R.S., said that when Sir Herbert Maxwell read his excellent paper, last March, at the Society of Arts, on the necessity of improving the methods of treating woodlands and forests, he mentioned the question of rabbits, and in the ensuing discusion, he (Sir Dietrich) remarked that in Richmond-park, at one time, there were many millions of rabbits, with the result that not an oak seedling was to be found in the enclosures. It was finally decided that the rabbits should be exterminated, and now hardly any rabbits were left in Richmond-park. The result had been that, to his great delight, he had seen last spring masses of seedlings springing up in suitable places. Among the suggested helps towards encouraging people to plant, Dr. Nisbet had urged the necessity of imposing import duties upon sawn and converted timber, but he presumed the duty would not be levied on Canadian timber, otherwise the nation would not be thinking imperially. In a few years by far the greater part of the coniferous timber imported into England will come from Canada. It was exceedingly gratifying to know that, through the action taken by Mr. Stewart in 1900 in establishing the Forest Association of Canada, the Dominion had taken the subject of the proper working of the forests in hand, and that Mr. Stewart had been made the Superintendent of Forestry. That was a most important step, because it would ensure a permanent supply of timber for this country, although not sufficient for all its needs. Sir Herbert Maxwell had proposed, in the paper he read before the Society, and also in an article in Blackwood's Magazine, that the State should purchase 1,000 acres of waste land a year, and plant it in order to set an efficient example. He knew how difficult it was in many places to get land for such a purpose, but 1,000 acres was not a very large area, and he thought it would be possible to find the land so that a beginning could be made. Dr. Schlich, in a short paper written twenty years ago, dealt with the question of afforestation in a most admirable manner. He then showed that the supply of coniferous timber was diminishing, although the demand was steadily increasing, and, after alluding to the large area of waste land suitable for planting (which, he agreed with Dr. Nisbet, was not as large as was usually stated), drew attention to the necessity of finding employment for the agricultural labouring population which was being attracted to the large towns. The real reason why land owners did not go in for planting was the uncertainty of the financial result. Dr. Nisbet, in his book, "The Forester," had stated that the data given by Dr. Schlich to the Departmental Committee on Forestry with regard to the Forests in Saxony were misleading. He did not approve of that criticism, because that particular forest was only one of many ranges in Saxony. There were no less than 10 ranges in different parts of Saxony which yielded over 40s. an acre net; in Baden there were nine ranges which yielded the same result, while some of them yielded as much as 53s. net per acre, the same remark also applying to Württemberg. He, therefore, contended that the instance Dr. Schlich quoted was in no way extravagant, and not misleading. The revenue from

forests in England was certain to be large. It was argued that there were no timber-consuming industries in the country, but there was no doubt they would soon grow up and rapidly increase, as at High Wycombe and in the oak forests of the Spessart, in Franconia. The revenue from State and private forests had grown in a most remarkable manner in different parts of Germany, the net revenue having trebled in some cases within twenty years, and there was no reason why the same thing should not occur in England. There was no country in Europe with a climate to be compared with that of England for the growth of coniferous timber, and he had often said that there was no country in the world which could produce better foresters. In Baden Baden there was a most delightful forest at Kippenheim of about 2,700 acres, a small area of which belonged to the State, and the remainder to village communities. That was a most important point, because the strength of Germany lay, not in the nobility who owned much of the land in Eastern Germany, but in the peasants who cultivated their own land. The villages he had mentioned owned an area of forest land which yielded an annual revenue sufficient to pay for the schools, churches, and roads; it paid the rates and local taxes, and provided fuel; and the peasants felt perfectly safe and contented because they were owners of communal property. The State is the guardian of all public interests, and the forests are therefore managed by State foresters, although the sale and distribution of the timber is left in the hands of the village council. In America, where forestry was now making such rapid strides, he supposed that the peasant proprietors did not need to be bound together by such village organisations, but in Germany, Austria, Switzerland, and France, he could not imagine that the village communities would be happy under any other system. He strongly recommended it to the attention of those who had the development of Ireland at heart, where a large body of peasant proprietors was now growing up, whether such an organisation could not be adopted with great advantage.

Dr. W. SOMERVILLE (Board of Agriculture) said that he had gone through a good many of the so-called forestry developments in this country during the last 15 years, and although the progress made might not have been on such an extensive scale as some extreme advocates would desire, he thought substantial progress had been made, and that the lovers of forestry and arboriculture had some reason to be satisfied and thankful. For instance, in 1889 there was no opportunity in this country for a British forester or a British landowner to obtain any systematic education in the subject. At that time the Indian forest officers were trained, to a large extent, at Nancy, and in many cases the terms charged were beyond the reach of the ordinary British forester. He did not say that at the present time a forestry school could be found in every county or attached to every University, but systematic education in forestry of a practical and systematic character could now be obtained in the University of Edinburgh, and opportunities for education were given to working foresters in connection with the Watt College. A Lecturer on Forestry was attached to the Glasgow and West of Scotland Agricultural College, and the North of Scotland College in Aberdeen was moving in the same direction. Instruction was also being given in the county towns of Scotland—Jedburgh, Perth, Kelso, St. Andrews, and such like places. At the University of Durham there was a well-equipped forestry department, not on the same scale as in Germany, but fairly commensurate to the demands made by British foresters for education. Instruction was being given at local centres such as Darlington, Carlisle, Durham, and Hexham; there was a healthy young department of forestry in the University College of North Wales at Bangor; and a forest school had been established under the auspices of Mr. Stafford Howard, in the Forest of Dean. All that had been done since 1889. The Royal Arboricultural Societies of England and Scotland were also extremely vigorous, and were publishing transactions, encouraging research, the writing of essays, the going abroad to study methods in foreign countries, and making representations to Government. The Surveyors' Institution encouraged the reading of papers and the holding of examinations in forestry; and the Carpenters' Company of London were giving substantial prizes for essays. The Departmental Committee on Forestry, which reported about two years ago, recommended, amongst other things, that so-called example plantations should be put down in connection with educational centres, and that had stimulated Mr. Marler to present an area of ground in the county of Denbigh, North Wales, to the Denbigh County Council. A scheme for an example plantation was now being worked out by the University College of North Wales, and in the course of a year or two the Denbigh County Council would own what Sir Dietrich Brandis had called a communal forest—the first of its kind in England. He hoped that example would stimulate other county councils to acquire land, either by gift or by purchase, for the purpose of demonstrating how the art of forestry in this country might be successfully practised. Reference had been made to the destruction caused by rabbits in forests, and he knew of thousands of acres of woodlands in the north of Scotland where not one single tree had retained its leaves on account of the damage done by squirrels. This had induced the chairman of the late Forestry Committee to remark, "What can you expect from forestry in this country when the rabbit reigns supreme at the foot of the tree and the squirrel at the top!"

The CHAIRMAN, in proposing a cordial vote of thanks to Dr. Nisbet for his interesting paper, said he intended to speak from a strictly practical point of view as the representative of the English landowner, who had always been tacitly assumed to be absolutely

incapable of managing his own affairs. All that had been done in the past was based upon a very different condition of affairs, both socially and economically, to what prevailed to-day. The fact was ignored that the production of underwood was the leading feature of English forestry up to the last twenty years, and he was expected in a moment radically to change all the systems which had proved to be as profitable in their time as any other system of forestry that could be quoted, even from Saxony. He thought a great mistake had been made by many lecturers and writers on the subject (among whom he would put Dr. Schlich as one of the first), in always saying what had been done in Germany, and not giving English experience. For 40 years he had been a student of nature, and had endeavoured to make himself acquainted with anything, not only in Germany but all over Europe, which would assist him in trying to make his land profitable. When a landowner was called upon to make large or even small, outlays upon his land, unless he had a bottomless purse he had to consider seriously the £ s. d. side of the question; and if the advocates of planting large areas of uncultivated land would show one single instance in any part of England where it could be proved that the woods on a large estate, taken as a whole, had paid a really fair return upon the capital invested, it would have been of much greater service in the encouragement of planting in England than by quoting what had heen done in the Black Forest and Saxony. He remembered going through many hundreds of pages of evidence given before the Committee on the Distress in Agriculture, in 1887, and read long extracts taken, by permission of the owners, from the estate accounts of many large properties in England, and he could not find a single instance which clearly proved that there had been a regular, steady profit worth talking about. No doubt, the argument would be advanced against that statement that the majority of large English landowners did not attempt to manage their woods for profit, but thought sport and shelter were more important. That was, undoubtedly, true of a great many of them, but not of such men, for instance, as Lord Yarborough, Lord Bathurst, the Duke of Atholl, and Lord Fitzwilliam, who planted their trees when the price of labour was only one-fourth or one-fifth of what it was at present, averaging from 4d. to 10d. a day compared with 2s. 6d. Another difficulty which he did not think had been sufficiently considered was the political difficulty. One could imagine, with 35 labour members in Parliament, all strongly supporting trade unions, and not one of whom had the least practical knowledge of what planting was, what would be the position of a district where a large area of land had been taken up by the State, and a lot of men happened to be out of work. Since 1809 attempts had been made to carry out in various places what Dr. Nisbet advocated in his paper, and if one considered the amount of capital that had been sunk in the attempt to sow thousands of acres of acorns in the Forest of Dean, looked at the result, and added up, with compound interest, the outlay that had been made, it would be found that, so far from planting being an industry which could be carried on in England with any certainty of profit, it was, in his opinion, one of the most risky financial operations that could possibly be undertaken. Though he did not say there was not a great deal of land which might be planted profitably, he fully agreed with Mr. Stafford Howard as to the difficulty of finding sufficiently large areas contiguous to places where the consumption of timber was regular and not over-weighted by foreign imports, to make it economically desirable. There was now being imported into England the pick of the trees of all the virgin forests of the world, which had only been made accessible during the last generation. All this timber was being thrown into England for nothing, except the cost of felling and transport, which was very small. If any tree had been considered a safe tree to plant for profit in England it was the larch. He had planted hundreds of acres of it, which, at present, he was trying to realise, but instead of getting, as he used to do, 1s. a foot, the highest price was not more than two-thirds of that figure. That was not an exaggerated case, and every practical man had suffered similar experiences. In planting trees, the landowner, first of all, did not know whether they would grow; that was decided largely by Nature. It might be argued that experience, skill and foresight would enable men to plant trees in such a way that they were sure to grow. He knew better. He had seen thousands of acres, planted by men with a life-long experience, which had been almost destroyed by a severe spring frost such as had been experienced four times in the last twenty years. He did not say that such things occurred on the better class of lands, but they happened on the waste land which it was recommended should be planted, where the risks and cost of planting were greater, and where the timber, when it was produced, was worth very much less than that produced on better lands. If he had *carte blanche* to plant for profit, so far from picking out the worst land, he would take the best he could get, because it not only gave the best return, but also the best quality. In competing with all the world for the production of timber, they had to try and produce the highest quality, because only the highest quality of timber was imported into England, and that could not be produced on inferior land. He asked the author, and all those who wrote or lectured without practical knowledge of the making and management of plantations, to remember that, although there were a great many things the landowners and foresters of England did not know and would like to know, they were not as absolutely devoid of common-sense and reason as they were sometimes assumed to be.

The vote of thanks having been carried unanimously, the meeting terminated.

Mr. BENNETT H. BROUGH writes:—The subject of the planting of waste lands for profit, so ably brought forward by Mr. Nisbet, was one of great national importance. Seeing that the value of the timber imported annually into this country is about £25,000,000, of which four-fifths represents coniferous wood, it ought to be possible to grow more of this class of wood in Great Britain. In the mining districts a good deal of attention is being given to the cultivation of timber on pit-banks and spoil-heaps. In South Staffordshire on the older spoil-heaps, owing to the disintegration of the shales, the soil is rich, and trees should attain a height of 25 feet in twelve years. In the German coalfields very satisfactory results have been obtained in planting spoil-heaps with acacia (*Robinia pseudo-acacia*). This tree can be grown upon very poor soil, and will yield useful pit-props after the lapse of 25 years. The wood has the property of resisting the effects of bad air and high temperatures very much better than oak.

Professor FRASER STORY, of University College of North Wales, writes:—"In Wales especially, one realises that the extent of waste land is out of all proportion to that under trees No earnest attempt at reafforestation has yet been made, but the movement in that direction is certainly a popular one. I sincerely wish your important meeting every success."

BRASSWORKERS IN BIRMINGHAM AND BERLIN.

Last spring a deputation of three left Birmingham for Berlin with the object of inquiring into the condition of the brassworkers of that city as compared with those of Birmingham. The deputation consisted of Mr. R. H. Best, Chairman of Best and Lloyd, Limited, Cambray Works, Handsworth; Mr. W. J. Davis, Secretary of the National Society of Amalgamated Brassworkers and Metal Mechanics; and Mr. C. Parks, Canvasser and Representative of the Birmingham Hospital Saturday Fund. Whilst in Berlin they extended their investigations beyond the particular trade named, and they have now published the result of their observations in a pamphlet entitled "The Brassworkers of Berlin and of Birmingham," which can be obtained of Messrs. H. S. King and Co., of Orchard-house, Westminster. It is not proposed here to deal minutely with the report, which deals with many subjects of great importance to the social reformer, but one or two points may be touched upon apart from the condition of the brassworkers, which, in the opinion of the deputation, is better in Germany than England. And first as to the apparent desire of the German Government to adjust the burden to the back. Under the English system of taxation, the workman, by which is meant the man of small income, gained by personal labour, can, if he chooses, escape almost all taxes. He does not pay Income-tax, and he need not pay the chief indirect taxes, upon tobacco, beer, &c.; but in Germany a different system is adopted. Take a brassworker, earning an average wage of 30s. a week. He contributes 6d. to 7¼d. per week to rates and taxes. The contributions are made in progressive amounts, according to his yearly earnings. One-half goes to the town and one-half to the State of Prussia. If his wages amount to from £45 to £52 10s. in the year, he contributes 12s. all told, half to the State and half to the town. If he earns from £67 to £75 per annum, his contribution all told is 16s. If he earns from £135 to £150, he contributes £2 12s. all told. The lowest wage, that of about 18s. a week, contributes 1·33 of his income; the highest, say £3, 3·47 per cent. This provides him with water, education for children, and, in the case of need, hospice for old people, infirmary for incurables, out-door poor relief, medical attendance and hospital, all of which are municipal institutions, and supported principally by rates and taxes. In the case of education in the higher schools, the fees are paid by the parents, but the public elementary schools in Berlin are free.

In Berlin there seems to be a fuller recognition of the need for avoiding the stigma of "charity" when relieving needy persons of good reputation. A wide gulf separates the treatment of the worker from the treatment of the non-worker—that is the vagrant, the loafer, the beggar, and the brawler. Disreputable persons are provided for as a separate class. The provision for working men and women in case of sickness, accident, old age, and infirmity was first proposed by Prince Bismarck in November, 1881, and the object was, to quote the message of the Emperor, as read to the Reichstag, to "render the needy that assistance to which they are justly entitled." The right to assistance is much more expressly recognised than in England, where hospitals, sanatoriums, and medical dispensaries for the working classes are rather regarded as instruments in the dispensation of voluntary subscriptions devoted to the relief of such as are objects of charity.

The Berlin workpeople have more freedom with regard to drink regulations. They may drink all Sunday, or all night, if they choose to do so. There are few total abstainers in Berlin. Temperance rather than total abstinence is aimed at. Slight effort is made to reclaim the drunkard, but the greatest energy is shown in the training of infants, children, and young persons. It is sought so to train the child that when he becomes a man he may be trusted to stand up against excess. Statistics are quoted by the deputation which if to be relied upon, and they appear to be official, show that drunkenness is not common in Berlin. The number of arrests for drunkenness in 1903 was 6,200, which represented 3 per 1,000 of the population; of these 4,983 were released when sober; 765 were delivered to the police and tried, and 393 per 1,000 were punished. The number of persons convicted of drunkenness in

Birmingham in 1904 was, according to the police report, 3,478, or about thirty times more than in Berlin, regard being had to the difference in population.

In the opinion of the deputation the working people are better nourished in Berlin than in Birmingham. "Nothing is wasted, everything is utilised and made the most of—nourishing broths from scraps of meat, bones, &c.—soups being a daily fare. Cooking is not taught in the Board schools, but by the mother. The system of payment is always cash, all clothing, boots, and food stuffs are paid for by cash—no credit." The heating-stove in general use wastes no heat and creates no dust or smoke. The fuel used is a patent fuel costing about 1s. a week. Working men usually have an allotment garden in which a certain amount of vegetables are grown. Meat, butter, ham, and bacon are dearer than in England, but most other things about the same price, or cheaper. From a statement showing the average cost per lb. or per article at Birmingham hospital and a Berlin hospital the following figures are taken:—

	Birmingham. Average cost.		Berlin. Average cost.	
	s.	d.	s.	d.
Fish	0	3·66 per lb.	0	6·31 per lb.
Fowl	2	0 each	1	9·18 each.
Butter ..	1	0·50 per lb.	1	0·50 per lb.
Cheese ..	0	5·76 ,,	0	5·69 ,,
Eggs	0	1 each	0	·63 each.
Milk	0	8·13 per gal.	0	5·77 per gal.
Bread....	0	0·93 per lb.	0	1·01 per lb.
Potatoes	0	0·50 ,,	0	0·25 ,,

Tobacco and cigars are cheap. "Cigars at one halfpenny are pleasant smoking, and rather above the price usually paid by a workman." Clothing costs about the same, but more economy is practised, and more care is taken of the garments. No men, women, or children are to be seen in the streets, or in the works, in an unwashed condition. The cost of travelling is very little. It is possible to travel twelve miles by electric tram for 10 pfg. or about 1⅕d. English money.

The deputation are responsible for the accuracy of the facts and figures given above. They would seem to show that the work people of Berlin get more for their money than the same class in England, and that the indigent who are not disreputable are better considered. It may be expected that some of the statements of the report will be traversed, but it deserves to be studied.

GLEANINGS FROM THE UNITED STATES RAILWAY RETURNS.

Gross Earnings.—About 27 per cent. of the gross traffic earnings come from the passenger train services. These are passenger revenue 421,704,592 dols. (22·18 per cent.), carriage of mails 41,709,396 dols. (2·19), expenses (*i.e.*, baggage and parcels), 38,331,964 dols. (2·02 per cent.). The gross earnings from the freight traffic were 71 per cent. of the gross traffic earnings. The freight revenue itself is returned as being 1,338,020,026 dols. (70·39 per cent.), and other freight services 4,846,718 dols., or 0·24 per cent. The remaining 2·46 per cent. is accounted for by other unspecified earnings and amount to 38,339,834 dols.

Summarised Expenditure.—The total operating expenses amounted to 1,257,538,852 dols., of which 266,421,744 dols. was spent on the maintenance of way and structures, 240,429,742 dols. on maintenance of equipment, 702,509,818 dols. on conducting transportation, and 47,767,947 dols. on general expenses. There is also the small item of 409,571 dols. returned as unclassified.

Itemised Expenditure.—The operating expenses are also enumerated in detail under some fifty-three sub-headings, from which a few items may be quoted, such as repairs of roadway amounting to over 139,000,000 dols., repairs of rails 17,395,000 dols., repairs and renewals of locomotives 92,964,000 dols., repairs and renewals of passenger cars 25,645,000 dols., repairs and renewals of freight cars, 93,396,000 dols. Among other figures mention may be made of locomotive fuel 146,509,000 dols., wages of engine and round house men 120,000,000 dols., wages of station staffs 88,625,000 dols., wages of men on trains 83,792,000 dols., and wages of switchmen, flagmen, and watchmen 54,123,000 dols. Items such as oil and waste for locomotives, cost of clearing wrecks, advertising, cost of stock yards and grain elevators, are chronicled in a manner which gives food for thought, and examples for quotation, to those desiring to secure more detailed returns from the Board of Trade.

Accidents.—So far as safety to passengers is concerned, the methods of railway operation in the United States leave much to be desired. The total number of passengers killed was 355, while 5,879 were injured: of these, the deaths due to collisions were 123, and the number injured was 2,975; derailments accounted for the deaths of 50 passengers, and 1,609 cases of injuries; by falling from trains 63 passengers were killed and 493 injured, while by jumping off trains, locomotives, or cars, 65 passengers were killed, and 1,066 injured. The number of railway *employés* killed was 2,070, and the number injured was 26,676. Despite automatic couplers 281 were killed and 3,551 injured in coupling or uncoupling. In collisions 574 of the staff were killed and 3,772 injured. In derailments 219 were killed and 1,634 injured. By falling from trains, locomotives, or cars, 551 were killed and 5,188 injured. Jumping on or off trains, locomotives, or cars, resulted in 198 fatalities and 3,920 injuries. The number of *employés* struck by trains, locomotives, and cars was large, no less than 1,151 being killed and 1,978 injured.

In addition to the staff casualties mentioned above, which occurred in connection with trains, loco-

motives, or cars in motion, 198 *employés* were killed and 27,661 injured during the performance of other duties, such as the handling of traffic, tools, machinery, supplies, &c.

A large number of deaths and accidents incurred by trespassers is also reported, a total number of 5,000 deaths and 5,079 injured being recorded.

Taxes.—As in the United Kingdom, rates and taxes levied by local authorities, tend to rise, so in the United States. The total sums paid in rates and taxes in the various States, but not including the sums paid to the United States Government, amounted in the aggregate to 57,797,737 dols., an average taxation of 290 dols. per mile of line. In the thickly populated States the rate per mile of line is considerably in excess of this average, being 1,413 dols. in Massachusetts, 1,025 dols. in Connecticut, 768 dols. in New Jersey, and 604 dols. in New York. Sparsely populated areas with low taxation such as Texas 108 dols., Arizona 125 dols., North Carolina 128 dols., also exist. The general average incidence of taxation per mile of line throughout the entire country rose by 16 dols., or from 274 dols. to 290 dols., in the 1903 fiscal year, over that recorded for 1902.

FRUIT-DRYING IN AUSTRALIA.*

Among the numerous infant industries of the Commonwealth, none can show a more certain promise of future development than that associated with the production of raisins, currants, and other dried fruits. Although in California, where the soil and climate closely resemble those of the southern half of Australia, fruit-drying has been made the basis of a large and remunerative export trade, the lesson thereby afforded was, until a recent period, completely lost upon the Australian colonists, notwithstanding it had been frequently pointed out that in those districts where the grape grew most luxuriantly the production of raisins of a good quality was attended with no difficulty. The establishment of the two irrigation colonies—Mildura, in Victoria, and Renmark, in South Australia—was followed by a rapidly-increasing output of raisins and currants, dried apricots and peaches, and other dried fruits of such an excellent quality that they went rapidly into consumption, demonstrating beyond all question the possibilities of the industry if conductd on sound principles.

At Mildura, 8,386 acres were under culture in 1903, the crops raised including currants, sultanas, peaches, and *citrus* fruits. About 2,509 acres are under gordos, 2,141 under sultanas, and 299 acres under currants, as compared with 1,931, 870, and 148 respectively three years previous. The rainfall is only about 9 inches per annum, but a plentiful supply of water is obtained by pumping from the Murray, the channels commanding an irrigable area of about 15,317 acres. In 1903, the returns from the sale of fruits amounted to about £100,000. Included in the output were 1,200 gallons of olive oil, 1,688 tons of raisins, 745 tons of sultanas, and 90,000 tons of citrous fruits. At Renmark, somewhat similar work is being carried on. Over 3,600 acres are under irrigation, and maintain a population of nearly 1,000 persons. The value of the fruits and olive oil sold amounted to £15,000 in 1903.

The other States also furnish excellent opportunities for the prosecution of the dried fruit industry, and for the building up of a large export trade in raisins, dried currants, figs, and other staples peculiar to the isles of the Levant and the Grecian peninsula. Wherever the Spanish muscatel has been introduced it has proved a very prolific bearer; and, were it more generally cultivated, there is no reason why raisins equal to the finest obtained from Muscatel should not be produced. In the Muscatel district the raisins are said to bring the vignerons a profit of from £40 to £60 per acre, and, all the conditions being fairly equal, the Australian-grown product should yield proportionately high monetary results. The main obstacle to the development of the dried fruit industry in Australia generally is want of knowledge and inexperience on the part of both *vignerons* and fruit-growers generally.

In New South Wales the State Government, recognising the importance of encouraging the infant industry, has engaged the services of competent instructors to impart practical information respecting the various processes; but some time must necessarily elapse before any tangible results are obtained. Here is the opportunity for those possessing the necessary experience, energy, and capital. Suitable areas for vine or fruit cultivation are readily procurable on favourable terms, especially in Queensland and Western Australia. Labour is moderately plentiful, and the cost of conveyance to the ports of shipment has been considerably lowered. How great are the capabilities of the Commonwealth for raisin production may be inferred from the fact that, in addition to the large quantity of grapes required during the season of 1903-4 for the manufacture of 6,221,798 gallons of wine, and 20,101 gallons of brandy, 22,349 tons were raised for table use. Currants and plums are largely grown in the cooler districts, as are apples and pears, while peaches, apricots, and nectarines abound everywhere. Yet, with all these opportunities, the Commonwealth imports considerable quantities of dried, tinned, and other preserved fruits, which could be produced as good and cheaply within its own boundaries.

* Communicated by Mr. John Plummer, of Sydney.

AFRICAN PETROLEUM.

According to recent reports, there are indications of the existence of petroleum beds in Portuguese East Africa, of which preliminary surveys have been made, and for the working of which a syndicate has been formed. Some years ago, a few business men

of Inhambane had their attention drawn to a peculiar deposit which incrusted the shores of a number of small lakes in the Nhangella Valley, which lies about fifty miles south-west of the port of Inhambane. This deposit, or crust, had been formed by the action of the wind blowing over the lakes, the surfaces of which were generally covered with thick layers of grease which was forced towards the shores, where it became mixed with fragments of grass and leaves and sand. This crust was quite hard, several inches thick, burned readily, and had long been used as fuel by the natives. It burned with a bright flame, and gave off a thick dark smoke, smelling very much like the smoke from burning kerosene. The American Consul-General at Lourenço Marques states that some geologists and chemists, to whom samples of the crust were submitted, pronounced it to be either elaterite or ozokerite, and reported that its specific gravity was 0·80, and its melting point 60° Centigrade. The soil in the neighbourhood of the lakes, is of fine sand, and the whole country shows evidences of having been at one time, in the remote past, covered by the Indian Ocean. Some prospecting showed that an extensive layer of limestone existed under this surface sand. With these facts before them, the discoverers of the deposit endeavoured to interest Johannesburg capitalists, and after persistent endeavours a syndicate was formed to prospect the country more thoroughly. Engineers were sent to the district to report upon its oil-bearing possibilities, and eventually a number of companies were formed, which took over considerable areas, under mineral concessions from the Government, and commenced drilling for oil. If petroleum is found in paying quantities—and according to the Consul, all the engineers and geologists who have examined the fields are confident that it will be found—it is intended to convey it by a pipe line to Lourenço Marques for final treatment, shipment, and sale, as the shallow harbour of Inhambane with its shoal channel across the bar, does not lend itself to any large commercial transactions of this kind. This pipe-line proposition is, however, strenuously opposed by some persons as being impracticable. Whether or not it is practicable will be determined later, but in Lourenço Marques it is said that there are plenty of good sites for refineries and for contiguous docks to serve them, and up to which vessels drawing from twenty-seven to thirty feet will be able to safely proceed. According to recent statistical statements, the world's petroleum production is as follows:—United States, 15,000,000 tons; Russia, 10,600,000; Sumatra, Java, and Borneo, 1,000,000; Roumania, 496,000; the East Indies, 404,000; all other sources, 250,000 tons. Astonishment is felt in regard to Roumania's rapid increase from an insignificant position to one which, if it goes on increasing, will enable it to compete with Russia. The production of 1904 was more than 3,000,000 tons larger than that of 1903. The yield of 1905, on account of events in Russia will, it is said, hardly reach that of 1903.

HOME INDUSTRIES.

German Consuls and Home Industries.—About two years ago the German Government issued a circular to all its consular officers directing them to place themselves unreservedly at the disposal of any of their countrymen, being manufacturers or merchants, who might seek their assistance. They were to give advice, or introductions, or information; in a word, assist the inquirer in all possible ways. Now a similar circular in more peremptory terms has been sent to these officials, and it is obviously the intention of the German Government to make their consular staff what may be called Trade Missionaries. Nor is the German Consul to limit himself to being of all posssible use to manufacturers and merchants who may invoke his assistance, and sending to the Home Government the usual annual report. He is requested to transmit any news of trade opportunities which may be of value to manufacturers and exporters the moment he is in possession of it. He is not to follow the leisurely fashion of other days, and be content to embody this information in his annual report, which may not be drawn up for months after the information is in his possession; he is to take the first opportunity of making it known in the Mother Country. In this way it is hoped and expected that the German Consul will be of much greater assistance to German trade than he has been in the past, because he will be more active in the collection and diffusion of information useful to manufacturers and merchants at home. It might be of much advautage to our own home industries if similar instructions were issued from our Foreign Office.

The British System.—As matters stand the service to trade rendered by British Consuls is mainly confined to their annual reports. Until a year or two ago these reports were not issued until long after they had ceased to be of practical value to manufacturers and exporters. Now they are issued much more promptly, but even now there is sometimes great delay. For example, the supplementary report on the trade and commerce of Cuba, issued last week, dated Havana, December 1, 1905, deals with the sugar crop of the island, but gives no figures later than those of 1903. Surely, in a report forwarded in December, 1905, it was reasonable to look for later figures than those of 1903. Apart from the annual report, and an occasional supplementary report, the British Consul does little to assist British trade. Even when he is willing and capable, the regulations more or less compel him to refuse information except through the medium of the Foreign Office. Instead of encouraging the Consul to take the initiative, and be the active ally of the trader, his official superiors seem unwilling that he should have any direct relations with traders. Again, although certain colonial officials have been designated to receive and answer commercial inquiries which may be addressed to them either by the Commercial Intelligence Branch of the Board of Trade, or by

British merchants and traders who may seek advice, it is to be feared that the answers given are of the baldest possible kind. The officials concerned mostly limit themselves to information touching their new departments, and Colonial Secretaries, and Treasurers, and the like, are not necessarily, or even commonly, in close touch with the trade wants and opportunities of the dependencies in which they serve.

Mechanical Haulage on Canals.—It has been pointed out by Professor Marchant that two systems are available for the employment of electricity in canal traction, the one involving the use of a tug, and the other a motor-car. An interesting trial is now being carried out by Messrs. Thornycroft and Co., who have fitted out a barge with their marine suction gas-engine, which is at present making a 1,000 mile tour of the canals. The experiment is said to have been very successful so far, the engine giving no trouble. It is of the vertical enclosed type, fitted with two cylinders, each $8\frac{1}{4}$ in. diameter by 11 in. stroke, and runs at about 300 revolutions a minute, giving about 38 h.p. on the brake. The further progress and completion of the experiment will be watched with interest. If our inland waterways are to be developed and used, as so many desire them to be, something quicker than horse traction may be necessary, but with the increased speed that comes of mechanical power there will be increased wash, and many of the canals are not constructed to resist the destructive action of the more rapid traffic in view. The barge now making its 1,000 miles experiment is of ordinary type, 71 ft. in length by 7 ft. beam. In France and Belgium the motor-car is in general use on the chief canals. The question of mechanical haulage on canals will no doubt be very fully examined by the Royal Commission about to be appointed by the Government to inquire into the whole subject of canal traffic in the United Kingdom. Some of the problems to be considered are not easy of solution.

Trade Returns for 1905.—On their face the Board of Trade returns for last year indicate very satisfactory expansion of trade during the past year. The increase in the volume of exports and imports was large, as will be seen from the following Tables, which give the gross figures for 1903-5 :—

1903-5 (in million £).

	1903.	1904.	1905.
Imports	542·6	551·9	565·3
Net Imports	473·0	480·7	487·5
Exports	290·8	300·7	330·0
Excess of Imports	182·2	180·0	157·5

The increase in the imports retained in the United Kingdom in 1905 is £6,800,000, as compared with £7,700,000 in 1904, or 1·4, as against 1·6 per cent. The figures of the export trade point to exceptional activity, but continuance of expansion is unlikely. The increase in British exports during the first nine months of 1905 amounted to £21,200,000, manufactures accounting for £19,200,000 of it. Of the total £8,000,000 was due to increases to China and Japan in nearly equal importance, yet these two markets take annually only 6 per cent. of our exports, whilst accounting for nearly 40 per cent. of our increased trade last year throughout the world. Not only is it unlikely that we shall see much further expansion in this direction but we must reckon with shrinkage. The expansion last year was largely due to the war, and now Japan is at peace she is certain to be a formidable competitor in Far Eastern markets. Again, the increased exports to the Continent in 1905 were in part made in anticipation of the new tariffs. The increase in cotton yarns and piece goods exported to all Europe except Turkey was 11,000,000 lbs. and 21,000,000 yarns, the increase to those countries which concluded treaties during 1905 with Germany amounted to 11,000,000 lbs. and 29,000,000 yarns respectively. Again, the increased exports of woollen yarns and manufactures amounting to £2,470,000 was due, as to £1,310,000, to changes in prices mainly of raw wool. When, however, all allowances are made the increase in the volume of the exports last year was satisfactory. A better test as to the condition of the export trade would be, as *The Times* points out, the remunerativeness of foreign trade in the last two years but this test cannot be made. Mr. Bowley in his *brochure*, "National Progress in Wealth and Trade," shows that in the last fifteen years the prices of imports fell on the whole more than those of exports, so that for a given quality of goods exported we received each year an increasing amount of goods in return, but there is reason to believe, if *The Times* is right, that, at least during the last three years, an opposite tendency has manifested itself.

Wheat and Flour Imports.—The Board of Trade figures for 1905 relating to the imports of wheat and flour show how great has been the change in the sources of our supply during recent years. Up to 1902 we looked in the main to the United States for our supplies of wheat and flour. In 1905 the position was radically different as the following tables show :—

Amount of Wheat and Flour in Equivalent of Grain (in Million cwts.).

	1900.	1901.	1902.	1903.	1904.	1905.
United States	50·9	66·3	64·7	46·2	18·3	14·0
Argentine	18·8	8·3	4·5	14·2	21·8	23·2
Russia	4·4	2·5	6·5	17·2	23·5	24·7
Canada	7·9	8·5	12·2	14·4	9·0	8·3
British East Indies	6·0	3·3	8·4	17·1	25·5	22·8
Australasia	3·6	7·6	4·3	0·0	11·7	10·4

The rapid shrinkage of our imports from the United States is not more remarkable than the growth of our imports from Russia. The imports from the United States will, no doubt, be much larger this year owing to the better crop, but their home requiremets are growing more rapidly than

production, and in the opinion of many authorities, the United States will soon cease to be a wheat-exporting country. Given peace and internal order, and we may expect to see, before long, further increases in imports of Russian grain, and the same remark applies to Argentine, where the Home demand increases much slower than the increase in cultivation. India and the Australasian Colonies must always be uncertain factors owing to the frequency of droughts; but our supplies from Canada should show large increases this year and onwards. Having regard to the great increase in the area under cultivation, it is a little surprising that the growth of our grain imports from Canada has not been quicker. It must, however, be remembered that the inrush to the North-West has been very recent, and that last year's crops were below the average.

CORRESPONDENCE.

OLD SILVER PLATE.

In further reply to Mr. Mastin's letter, all I can say with regard to the piece or pieces bearing the marks of the two Standards is that, up to the present such examples have never been known (even to such an authority as Mr. C. J. Jackson who, like myself, doubts their existence), and I should be very much obliged to Mr. Mastin if he would kindly inform me where any single example which he considers so marked may be seen. The only "means of identification" for which the Sovereign's head was used, was to prove that the duty had been paid. I maintain that the "Lion Passant" was used in 1544 for the first time, because no plate of 1543 bears that mark, whilst every known example of 1544 has it. This I submit proves the definite year of its introduction, and if Mr. Mastin will take the trouble to read pages 66 and 67 of "English Goldsmiths and their Marks" (Macmillan and Co., 1905), since the publication of which book other examples have been found confirmatory of the above statement, I think he will agree as I do with all that Mr. Jackson has there written on the subject.

LIONEL A. CRICHTON.

January 22nd, 1906.

GENERAL NOTES.

THE STATISTICS OF PAUPERISM.—The Blue-book recently issued on pauperism (England and Wales) shows that the rate per 1,000 of estimated population, 25.5, is higher than for any year since 1896, when it was 25·7, a point to which it had receded from 35·1 in 1873, the year in which complete returns for England and Wales were first obtained. Perhaps the most significant table in these returns is that which relates to the insane. The total number of persons relieved on the 1st July last as lunatics, insane persons, and idiots, including those in workhouses and on the out-door relief rates was 107,728, forming 12·4 per cent. of the total pauperism of England and Wales. The proportion in London was higher, being no less than 17·8 per cent. Since 1873 the number of the insane has more than doubled, and if we go back another thirty years, to 1843, and take Sir J. Nicoll's figures, it will be found that whilst the population had not been more than doubled, the number of lunatics, insane persons, and idiots on the pauper lists has increased nearly sevenfold. Again, if we cover a still longer period in review and go back to the year of the famous Poor Law Inquiry Commission Report of 1834, it will be found that the cost of pauperism per head of the population was almost as high in 1904 as seventy years earlier. In 1834 it was roundly 8s. 6d. and in 1904 8s. And this notwithstanding that wheat was not much more than half the price per quarter in 1904 that it was in 1834. The recent rapid growth in the cost of poor relief is no doubt attributable to more attention being paid to the comforts of the pauper, but it is to be feared that establishment charges account for an undue proportion of the increased expenditure per head.

ARTIFICIAL GRANITE.—The United States Consul at Baden says that an invention, which relates to the manufacture of artificial granite for use in building and other purposes, was recently registered. The object of the invention is the production of a cheap and durable material, which, when set, has the appearance of granite, and which can be used for many, if not all, of the purposes for which natural granite is employed. For the purposes of the invention, granite or marble chips, or both, are taken and mixed with a suitable proportion of cement, water, colouring matter and other ingredients, if desired, until it forms a hard, consistent paste. The mixture is then placed in moulds, in which it is allowed to remain until set, after which the blocks are removed and immersed in water until they have absorbed sufficient moisture. They are then removed and placed in a warm and shady place until they have attained the required dryness and hardness, after which they are polished.

RUBBER PLANTING.—At present, largely owing to the existance and encouragement given by the Government and the Botanical Departments at Kew and Ceylon, and the easily available land in the Malay Peninsula and other Colonies, the British rubber-planting industry leads the world. But elsewhere the industry has grown, and is growing apace and notably in Mexico. The Hidalgo Plantation and Commercial Company, owning among others the famous La Zacualpa plantation, is believed to have on that one estate something like 2,500,000 trees. The

Mexican Mutual Planters Company again owns large plantations of *Castillon Elastica*. Professor Olsson-Seffer, instructor in sytematic botany at the Leland-Stanford University, recently paid a long visit to the Mexico rubber plantations on behalf of his Government, and has just sailed for the Philippines to examine and report on the advantages of these islands for rubber production. In Liberia, again, there are vast forests largely filled with rubber trees which are being exploited by British capitalists; and some efforts are being made to increase the forest growth by planting in the West India islands where climate and soil are very suitable. Java again is expected to export very large quantities of rubber in the course of the next few years. Altogether it would seem that whilst the demand for rubber is steadily and even rapidly increasing the sources of supply are expanding in at least equal degree.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

JANUARY 31—"The Garden City and the Cheap Cottage." By THOMAS ADAMS. FABIAN WARE, Editor of *The Morning Post*, will preside.

FEBRUARY 7.—"Progress in Electric Lighting." By LEON GASTER, A.M.I.E.E. SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

FEBRUARY 14.—"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON. COLONEL H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 21.—"The Fisheries of the North Sea." By WALTER GARSTANG, M.A. EDWIN RAY LANKESTER, M.A., LL.D., F.R.S., will preside.

FEBRUARY 28.—"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.). SIR JOHN WOLFE-BARRY, K.C.B., LL.D., F.R.S., will preside.

Dates to be hereafter announced:—

"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.

"Submarine Signalling." By J. B. MILLET.

"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"Industrial Russia." By LUCIEN WOLF.

"The Artistic in Painting and Photography." By J. C. DOLLMAN, R.I.

"Motor Boats." By BERNARD B. REDWOOD, B.A.

"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT.

"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE.

"Power Transmission and Coal Conservation." By ARTHUR J. MARTIN, Assoc.M.Inst.C.E.

"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By PROFESSOR THOMAS OLIVER, M.D., LL.D.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 15.—"The Navigable Waterways of India." By ROBERT BURTON BUCKLEY, C.S.I.

MARCH 15.—DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit., "The Languages of India and the Linguistic Survey."

APRIL 26.—COLONEL SIR ARTHUR HENRY MCMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

FEBRUARY 6.—"Imperial Immigration." By OCTAVIUS CHARLES BEALE, President of the Federal Council of the Chambers of Manufactures of Australia.

MARCH 6.—"Imperial Questions in the West Indies." By SIR NEVILE LUBBOCK, K.C.M.G.

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock:—

JANUARY 30.—"The Chemistry of Artists Colours in relation to their Composition and Permanency." By J. M. THOMSON, LL.D., F.R.S. SEYMOUR LUCAS, R.A., will preside.

FEBRUARY 20.—"Illuminated Manuscripts." By H. YATES THOMPSON, F.S.A.

MARCH 20.—"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A.

APRIL 24.—"Cut Glass." By HARRY POWELL.

MAY 24.—"Basket Making." By THOMAS OKEY.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." Five Lectures.

LECTURE I.—JANUARY 29.—Characteristic features of warships—Materials of construction—Structural arrangements—Operations of building and launching.

LECTURE II.—FEBRUARY 5.—Armour protection—Systems of disposition—Methods of manufacturing armour plates—Recent improvements in quality, and consequent changes in designs of warships.

LECTURE III.—FEBRUARY 12.—Armaments—Progress in the design and manufacture of guns, mountings and machinery for working heavy guns—Improvements in projectiles and explosives.

LECTURES IV. AND V.—FEBRUARY 19 and 26. —Recent types of warships, British and Foreign—Battleships — Armoured and protected cruisers—Scouts—Torpedo boats and destroyers—Submarines.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

HOWARD LECTURES.

Thursday evenings, at 8 o'clock :—

PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., "High Speed Electric Machinery, with special reference to Steam-Turbine Machines." (Three Lectures.)

LECTURE III.—FEBRUARY 1.—*Turbo-alternators.* —Relation between frequency, number of poles, and revolutions per minute—Relation between frequency, surface-speed, and pole-pitch—Turbine speeds and field-magnet design — The limitations of magnet design — Balancing — Armature - design in alternators — Nature of armature reaction—Armature-design as affected by power-factor of the load—Mechanical considerations — Ventilation of turbo-alternators—Forced ventilation—Efficiency; overload possibilities; limits of design—Excitation of field-magnet system—Preference given to very low voltage of excitation—Examples of turbo-alternators.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Sir William White, "Modern Warships." (Lecture I.).

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. F. Marshall, "The Valuation of Machinery for the Purposes of Rating."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Rev. Canon Benham, "A Walk through Westminster."

TUESDAY, JAN. 30...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Dr. John M. Thomson, "The Chemistry of Artists' Colours in relation to their Composition and Permanency."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. E. H. Parker, "Impressions of Travel in China and the Far East." (Lecture III.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Frederick Robert Upcott's paper, "The Railway Gauges of India."

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. 1. Mr. Adolphe Minet, "The Electric Furnace: Its Origin, Transformations and Applications." Part III. 2. Dr. J. A. Harker, Demonstration of a New Electrolytic Tube Furnace. 3. Mr. E. B. R. Prideaux, "Note on the Production of Ozone by Electrolysis of Alkali Fluorides."

WEDNESDAY, JAN. 31...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Thomas Adams, "The Garden City and the Cheap Cottage."

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, FEB. 1... SOCIETY OF ARTS, John-street, Adelphi, W.C. 8 p.m. (Howard Lecture.) Prof. Silvanus P. Thompson, "High Speed Electric Machinery, with special Reference to Steam-Turbine Machines." (Lecture III.) "Turbo-Alternators."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. Mr. J. Stanley Gardiner, "An Account of the Percy Sladen Trust Expedition to the Indian Ocean in H.M.S. *Sealark*."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. T. Haga, "Hydroxylamine-$\alpha\beta$-Disulphonates (Structural Isomerides of Hydroxiamino-Sulphates or Hydroxylamine-$\beta\beta$-Disulphonates.") 2. Mr. M. C. Forster, "Studies in the Camphane Series." Part XXI. "Benzenediazo-ψ-Semicarbazino-Camphor and its Derivatives." 3. Messrs. A. W. Stewart and E. C. C. Baly, "The Relation between Absorption Spectra and Chemical Constitution." Part I. "The Chemical Reactivity of the Carbonyl Group." 4. Messrs. E. C. C. Baly and A. W. Stewart, (*a*) "The Relations between Absorption Spectra and Chemical Constitution." Part II. "The Quinones and α-Diketones." (*b*) "The Relation between Absorption Spectra and Chemical Constitution." Part III. "The Nitranilines and the Nitrophenols." 5. Mr. F. D. Chattaway, "The Action of Light on Benzylidenephenylhydrazine." 6. Messrs. D. L. Chapman and C. H. Burgess, "The Union of Chlorine and Hydrogen." 7. Messrs. G. Barger and A. J. Ewins, "Note on the Molecular Weight of Adrenaline." 8. Mr. J. Campbell Brown, "The Critical Temperature and Value of $\frac{ML}{O}$ of some Carbon Compounds."

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. F. E. Fritsch, "The Microscopic Plants of our Waters and their part in the World's Economy."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. B. Ridd, "The Significance of the Future in the Theory of Evolution." (Lecture I.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. F. L. Watson, "Destructor Bye-products."

FRIDAY, FEB. 2...Royal Institution, Albemarle-street, W., 9 p.m. Prof. Silvanus Thompson, "The Electric Production of Nitrates from the Atmosphere."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Early Italian Engraving."

Geologists' Association, University College, W.C., 7½ p.m. Annual Meeting. Address by the President, "The Study of Fossil Fishes."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

SATURDAY, FEB. 3...Royal Institution, Albermarle-street, W., 3 p.m. Mr. J. W. Gordon, "Advances in Microscopy." (Lecture I.)

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FRIDAY, FEBRUARY 2, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 5, 8 p.m. (Cantor Lecture.) SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." (Lecture II.)

TUESDAY, FEBRUARY 6, 4.30 p.m. (Colonial Section.) OCTAVIUS CHARLES BEALE, "Imperial Immigration."

WEDNESDAY, FEBRUARY 7, 8 p.m. (Ordinary Meeting.) LEON GASTER, A.M.I.E.E., "Progress in Electric Lighting."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, January 29, SIR WILLIAM WHITE, K.C.B., F.R.S., delivered the first lecture of his course on "Modern Warships."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday evening, January 30; SEYMOUR LUCAS, R.A., in the chair. The paper read was "The Chemistry of Artists' Colours in relation to their Composition and Permanency." By PROFESSOR J. M. THOMSON, LL.D., F.R.S.

The paper and report of the discussion will be published in a future number of the *Journal.*

HOWARD LECTURES.

On Thursday evening, 1st inst., PROFESSOR SILVANUS P. THOMPSON, D.SC., F.R.S., delivered the third and last lecture of his course on "High Speed Electric Machinery with Special Reference to Steam Turbine Machines," the subject being Turbo-alternators.

On the motion of the CHAIRMAN, a vote of thanks was passed to Dr. Thompson for his valuable course of lectures.

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, January 18; SIR JAMES L. MACKAY, G.C.M.G., K.C.I.E., in the chair.

The paper read was—

THE CITY OF CALCUTTA.

By CHARLES EDWARD BUCKLAND, C.I.E.

When I had accepted the honour of an invitation to address the Society of Arts on the subject of Calcutta, I soon found that it would be difficult to treat it adequately within the time usually allowed for the reading of a paper. The official and non-official literature regarding Calcutta is voluminous; and the subject admits of being regarded from several points of view. I should have liked to deal exhaustively with Calcutta, as a whole, to trace its development from its early origin to its establishment as the Capital, first of Bengal, afterwards of India, to work out thoroughly the historical, commercial, municipal, and administrative divisions of the subject, with a view to arriving at the reasons for the position of Calcutta as the second city in the Empire. Not only would time be wanting for such an exhaustive paper, but limitations have been imposed on me in two directions. At a

meeting of this Society on the 1st June, 1899, Sir Charles Stevens read a paper on the Port of Calcutta, in which he sketched the earlier history of the East India Company in Bengal, before the foundation of Calcutta by Job Charnock, and entered very fully into the work of the Port Commissioners of Calcutta, the projects carried out by them, the volume of trade passing through the Port, and their various schemes for keeping open and ameliorating the navigation of the river Hugli. And later, on January 23rd, 1902, Mr. F. H. Skrine addressed the Society on "Bengal, the Land and its People," when, in summarising the history of the Province, he was obliged to refer constantly to its Capital. I must, therefore, refrain as much as possible from travelling over the ground occupied by previous addresses to the Society, but will use the time available to give some account of the history, development, and progress of Calcutta, to mention some of the principal events there during the last 200 years, and to give some idea of it at the present day. I may claim some local knowledge, having spent the greater part of 33½ years' service in the city, and having been constantly concerned in some capacity or other with its administration and politics. I have also had access to various publications which, though open to anyone, few people would have time to consult. It would be irksome to quote the authorities for each statement made, but it may be mentioned that I have generally relied on the late Dr. C. R. Wilson's "Early Annals of the English in Bengal," the Rev. H. B. Hyde's "Parochial Annals of Bengal," several Census Reports of Calcutta, Mr. A. K. Ray's "Short History of Calcutta," Miss Blechynden's "Calcutta: Past and Present," a number of old articles in the "Calcutta Review," my "Bengal under the Lieutenant-Governors," the "Selections from the Calcutta Gazettes," Dr. Busteed's "Echoes from old Calcutta," and on other miscellaneous official and non-official sources of information. Without further preface I now proceed to my subject, which I propose to divide into several sections.

Description.

To understand Calcutta it is necessary to have at least some general knowledge of its geographical features, its appearance, its climate, and its physical conditions. Calcutta is situated in latitude 22° 33′ N, and longitude 88° 23′ E, on the left or east bank of a branch from the main stream of the river Ganges, the branch known in its upper course as the Bhagirathi, and called the Hugli before it reaches Calcutta and discharges itself into the sea beyond Saugar, after a further course of 80 to 100 miles below Calcutta. Some parts of the town lie beneath high water mark on the Hugli; its low level has rendered drainage a most difficult problem. The river as it passes Calcutta runs nearly north and south until at Shalimar Point it takes a decided bend to the westward. The town proper is in shape an irregular parallelogram, bounded on the west by the river, on the north by the Chitpur Canal, on the east by the Circular Canal and the Circular-road, by the latter on the south as far as Alipur Bridge, and from that bridge to the river by Tolly's *nullah*; it is about 5½ miles long by 2 to 2½ broad. The northern portion of the town is occupied entirely by the natives. The middle contains the business quarters which concentrate, speaking generally, on Dalhousie-square and the public offices. The southern portion is cut by Chowringhi-road, which runs nearly north to south, into two divisions, first the *maidan* on the west, and, second, the residential European quarter on the east. The Fort, the Second Fort William, is on the north-west portion of the *maidan*. Of this *maidan*, or open plain, dotted with trees and intersected by roads and avenues, Calcutta residents are justly proud and jealous. It has been called the lung of Calcutta. Its area, about four square miles, affords space for the parades and sham-fights of the regular troops, of the garrison of the fort, and the volunteers, for the racecourse, for games, for walking and driving, at all seasons of the year. The larger town of Calcutta, as defined for municipal purposes, includes the wards of Entally, Baniapukur, Ballyganj, Tollyganj, Bhawanipur, Alipur, and Ekbalpur. The adjacent suburbs of Cossipur-Chitpur, Manicktollah, and Garden Reach are structurally an integral part of Calcutta, connected by a continuous stretch of buildings, though forming separate municipalities. On the west side of the river is the Howrah municipality, including the ancient villages of Ghooseri, Salkia, Howrah, Betor, and Sibpur, and bearing the same close relation to Calcutta as Southwark bears to London. Calcutta has long been called the City of Palaces. The original authority for the expression is unknown. Lord Macaulay repeated it, apparently with approval, but the city is not generally considered to deserve the

appellation, which has also been bestowed on Oxford, Bath, and Genoa. Lord Lytton, with more truth, called Calcutta the City of Statues, of which there are a goodly number, chiefly of Governor-Generals and military heroes. If the appearance of Calcutta is compared with that of other cities, it must be remembered that the grey stone, which has admitted of Bombay being made so beautiful, is not available in or near Calcutta, and that the latter has to depend on burnt bricks and plaster as the material for its larger buildings. But Dalhousie-square would be a conspicuous feature in any town, with its fine public edifices and sheet of water. The Esplanade, running west to east, from Chandpal Ghat, contains the High Court, Town Hall, Treasury Buildings, Government House, and the new Military and Foreign Offices, a range of buildings of imposing appearance. On Chowringhi-road, which is at right angles to the Esplanade, buildings of various sizes and uses are located, such as hotels, clubs, the museum, residences, presenting a broken line of stately mansions. After the Fort, which cannot be called ornamental, the most conspicuous object on the *maidan* is the Ochterlony Column, 165 feet high, in honour of Sir David Ochterlony, the General who successfully concluded the Nipal War of 1815, a monument which has been disparaged for its resemblance to a lighthouse, but from its summit an extensive view can be obtained; and, at the south-east corner of the *maidan*, St. Paul's Cathedral, with its spire rising out of a group of trees, forms a pretty picture, but it is a modern structure, dating only from 1847. The disfigurement of the *maidan*, the old jail at its south end, will fortunately be removed when the Victoria Memorial Hall is erected to the north of the site of the jail. The native part of the town contains a number of buildings connected with Education, such as the Senate House and the Medical College, concentrated on College-square, also many of the ancestral mansions of wealthy native gentlemen, such as the Tagores, the Mullicks, the Sobhabazar family, the Marwari houses, and many others; but they are too closely surrounded by the lowly dwellings of the poor to admit of their showing to advantage. It is a common remark that there are few fine objects to show English visitors to Calcutta. I have generally found them best pleased with the Botanic and Zoological Gardens for the beauties of their tropical foliage and effective landscapes.

The climatic conditions of Calcutta are the most important consideration for its residents and visitors. The normal annual rainfall is about 66 inches, ranging from 39 to 97 inches; the greater part of the fall occurs between June and the middle of October, during the prevalence of the south-west monsoon; but the violent thunderstorms of February, March, and April, may give heavy rain, and it is an old tradition that there is always rain about Christmas in Calcutta. The year may be roughly divided into three seasons, the hot weather from the middle of March to the end of June, the rains from the end of June to the middle or end of October, and the cold weather from November to the end of February. But the changes in the seasons occur gradually, and the years vary in respect of the amount and distribution of the rainfall. For instance, the normal rainfall between May and October is about 55 inches, but in 1900 it reached nearly 86 inches. It is on record that, in a thunderstorm at Calcutta, over an inch of rain fell in ten minutes, that is at the rate of nearly seven inches per hour. The temperature throughout the year is seldom unbearably high, but in some years the month of June has been so hot that applications have been made to close the law courts, business has been conducted in great discomfort, and animals as well as human beings have suffered severely from the heat. Since the introduction within the last few years of punkahs worked by electricity, the effects of the temperature within doors have been greatly mitigated by night and by day. The average mean temperature of Calcutta is 78·5°, ranging from 66·3 or ·2° in December and January to 86° in May, and nearly 83° in September. During the rains it is 83·3°. Of other places in India, Rangoon is the lowest at 82°, and Lahore the highest at 90°. The mean humidity at Calcutta at 8 a.m. is 88·5 per cent., Rangoon being the highest at 93·8 and Lahore the lowest at 70·5. The mean cloud amount is 8·4, where 10 represents an overcast sky. In the cold weather the temperature resembles that of a pleasant summer day in Europe with the certainty of its continuance. With due protection for the head against the rays of the sun, anyone can enjoy outdoor life throughout the day. The actual height of the thermometer and the feeling to the individual depend largely on the prevailing wind. In the cold weather the wind often blows straight from the Himalayan range to the north of Calcutta, for days or weeks together.

Of the Calcutta climate the humidity is perhaps the most noticeable feature. The

ground becomes sodden with moisture during the rains, so that, when it is drying under the heat of the sun, there is a constant mist hanging over the city, and thick heavy fogs cover the lower areas; fevers become rife among the native population and their health is generally at its worst. September is the most trying month of the year; not only is the ground saturated but the sky has a leaden appearance and the sea breeze from the south, which is so welcome throughout the rest of the year, often fails. In short, the atmosphere of Calcutta for many months resembles a vapour bath, varying in temperature and humidity according to the season. In such a climate human and animal life endure for many years, but not without enervation and deterioration; the blood becomes attenuated from the perpetual heat and damp; the human frame cannot be maintained in the same vigour as in a European climate and is sooner exhausted; health can only be preserved by great precautions. "We don't come to Calcutta for our health," said a Calcutta tradesman to a customer. At the same time it is only fair to add that the health statistics of Calcutta are among the best of the large towns of India, and that they have improved greatly since the introduction of filtered water and better sanitation.

The death-rate in 1904-5 was 30 per mille of the municipal population, plague being responsible for 5·5 of the mortality; in 1904 there were 4,995 cases of plague. After all is said Calcutta is, in point of climate, a good place to get away from, but from the manner in which Europeans and natives alike rally on visiting the cooler climates of the hills or England it is evident that the Calcutta climate is only unpleasant and temporarily weakening, rather than intolerable or actually deadly. In spite of climate, however, few cities have so quickly attained such a position as it now holds. It is British enterprise and British energy, as a native writer has recently acknowledged, that have changed three villages, situated on a malarious soil and yielding a revenue of 900 rupees a year, into the Capital of India, with an enormous population and a vast trade, and a revenue of nearly 60 lakhs of rupees. British Trade is, and has ever been, the dominant element in Calcutta. Native Trade has, of course, contributed its share, but the native element has not been so prominent in Calcutta trade as it has been in Bombay. Calcutta is to all intents a European city in an Indian environment, and it bears testimony to the capacity of the Anglo-Saxon race for colonisation and empire.

The Earlier History.

The history of Calcutta, chiefly the earlier history, was written at some length three or four years ago by an able and industrious Indian gentleman, Mr. A. K. Ray, a member of the Cirencester Agricultural College, who has devoted several chapters to describing it, "Beneath the Surface," "In Legend and Poetry," "In Tradition and Story." These aspects need not detain us long. The Hindu legend regarding the formation of land and water in the neighbourhood of Calcutta, as traditionally known to the people of the locality, was narrated by a writer of the sixteenth century, who stated that a tortoise, too heavily pressed by a mountain on his back and by the Infinite, gasped a deep breath, and the country of Kilkila, 160 square miles, containing the site of the present Calcutta, was formed. Mr. Ray, after recounting the traditions and the geological theories advanced, concludes that there are good reasons for thinking that in remote antiquity gneissic hills stood out from the sea where Calcutta now is, that at a later date these hills were depressed and a tidal swamp covered the area, that the lower Gangetic plains began to be elevated by fluvial deposits about 4,000 to 5,000 years ago, that near Calcutta an elevation of the area has alternately been followed by a subsidence, that in historic times the area including Calcutta was not finally formed in the seventh century of the Christian Era. It may have been forgotten that between 1835 and 1840 boring operations were conducted in Fort William under a Committee of Naturalists: they sank a bore hole 460 feet below mean sea-level, found no marine deposits but peat-beds at 30 to 35 feet, and again at 385 to 392 feet below the surface, fine sand and sea shore pebbles, mostly derived from gneissic rocks, at three different depths down to 480 feet below the surface. In continuation of its underground history, adds Mr. Ray, Hindu legend furnishes us with a story of Calcutta. According to it, the site of the town must have been sufficiently raised for human habitation before the twelfth century A.D., and its name, Kalikshetra, or field of Kali, an area of about two square miles, was derived from an aboriginal goddess, Kali, who was absorbed into the Hindu pantheon. Her original temple is said to have sunk into the ground during an earthquake in the fifteenth century, after which

her shrine was re-established at Bhawanipur, and later again at the present site at Kalighat on the Adiganga, the old channel of the river Ganges, now known in its diminished and artificial state as Tolly's *nullah*. An immemorial pilgrim road led to Kalighat, generally following the line of the present Chitpur-road, Chowringhi, and the Bhawanipur-road. There is some evidence, based on a Bengali poem, that there was in 1495 A.D., a village called Kalikata, south of Chitpur, as well as the temple of Kali. Thus Calcutta and Kalighat were, and are, in fact, different places. The name Calcutta of the village was probably, it is suggested, derived from some aboriginal language. The first historical notice of Calcutta is to be found in the well-known Ain-i-Akbari, written in 1596 A.D. by Abul Fazl, the Prime Minister of the Emperor Akbar. It is mentioned as one of three towns in the district of Hugli—then called the Sirkar of Satgaon—jointly paying a certain sum of revenue into the Imperial exchequer. In the Ain the name is given as Kalkatta, as now pronounced by the natives, but in old books the name appears variously as Calicotto, Collekotta, Collecotte, Kolekota, and even Golgota, or, as mariners called it, Golgotha. Modern Calcutta covers the site of the three old villages, Sutanati, Calcutta, and Govindpur. It was Sutanati that Job Charnock, on the order of Aurangzeb for the admission of the English, and not without hesitation, trusting to the promise of Ibrahim Khan, then "the famously just and good" Nawab of Bengal, occupied for the third time, on Sunday, August 24th, 1690, being received with respect by the Mogul commander of the Thana fort and the native Governor of Hugli. This then is the date of the foundation of Calcutta. At first it was one of three mere riparian villages, consisting of mud and stone hovels, with a few masonry buildings which soon increased in number. Capt. Alexander Hamilton, an independent merchant, who traded in the Eastern seas from 1688 to 1723, wrote as a contemporary that Charnock "could not have chosen a more unhealthy place on all the river," and 45 years ago a Calcutta reviewer wrote: "Calcutta is the child of trade. Charnock founded it with mercantile views on the eastern bank of the Hugli, though the western was the more healthy." Job Charnock might well have said, in the prophetic vein of the Latin poet:—

"Hic locus urbis est, requies ea certa laborum."
(Æn. 3.393 and 8. 46.)

For more than 50 years the East India Company's agents, trying to find settlements for their trade in India, extended their factories from the Spice Islands of the Archipelago to the Coromandel Coast, from that coast up to the Bay of Bengal, from Balasore to Hugli, from Hugli, after further wanderings, to Sutanati. "Errabant acti fatis maria omnia circum." Their policy had varied with their movements. At first it was one of entirely peaceful commerce. This gave place to a policy of force and retaliation; a third stage was the policy of peaceful commerce, with force and aggressive measures in reserve. Job Charnock, a shrewd man of experience, who had then been in India 33 to 34 years, chose, at Sutanati, the present site of Calcutta with deliberation. It was indeed the only possible Port on the East of India. He chose it, though unhealthy, as a strategically safe spot and an excellent commercial centre: safe, because it was on the east bank of the river, protected on its east and south sides by morasses, on its west side by the river in the possession of the English naval power, admitting an attack from the north side only: an excellent commercial centre, as the place where the stream became much shallower, where the inland navigation was possible by river and channels, where country produce could be brought down in boats and carried away by seagoing vessels: where the pilgrim road afforded communication with the interior: where native families had already established a market to do business with our predecessors, the Portuguese. The evidence all tends to show that, after much labour and wandering, the site of Calcutta was deliberately selected by the highest local authority. "Tantæ molis erat Romanam condere gentem." But little rest from their labours awaited the early settlers. On the 10th of February, 1691, an order was issued by the Mogul Emperor, allowing the English to continue their trade in Bengal on payment of 3,000 rupees annually in lieu of all dues. But Aurangzeb had allowed the French to settle at Chandernagore, twenty miles up the river, in 1688, and there was war between France and England in which the young settlement had no strength to take part. It is sad to relate that Charnock succumbed to the hard work of his life. He had "reigned more absolute than a Raja," and with some violence. His health gave way, says the chronicler, habits of indolence crept over him, his spirit failed him, his temper grew moody and savage, the reins of

government slipped from his relaxing fingers. On the other hand, though imperfectly educated, he had, it is said, the rare virtue of disinterested honesty; though he became indolent and indecisive he had, in his prime, resolute determination, clear-sighted wisdom, and had exhibited honest self-devotion. His domestic arrangements may be overlooked; his public acts, as the founder of a great city, entitle him to the favourable recollection of posterity. On the 10th January, 1692, he died. The inscription on the slab in his mausoleum in the oldest cemetery of Calcutta, now St. John's Church compound, bears the date, 1692, which means 1693, New Style. The Indian Census Report of 1901 must surely have erred in stating* that Job Charnock occupied Calcutta in 1696.

The Later History.

The history of Calcutta subsequent to its foundation may be divided into three periods: the first, from Charnock's death to the assumption by Warren Hastings of the office of Governor-General in Bengal, in 1774; the second from 1774 to 1854, when the first Lieutenant-Governor of Bengal was appointed; the third from 1854 to the present time; periods of 82, 80, and 52 years respectively.

1692-1774.

From 1692 to 1774 Calcutta, as part of Bengal, was under rulers variously designated as Agents, Presidents and Governors. But few of them will it be necessary even to name. Sir John Goldsborough arrived in August, 1693, as Chief Commissary and Chief Governor of the Company's Settlements, which he was instructed to reform. By the end of the year he was dead. The times were troublesome, Aurangzeb, in anger and revenge, suspended the trade privileges of the English, but the local native authorities connived at the evasion of the imperial order, so that trade continued. In 1696 local rebellions, including that of Subha Singh, broke out against the authority of the Nawab, Ibrahim Khan, who allowed the Calcutta Government to construct fortifications. In 1698 the Calcutta Agent bribed the Nawab Azim-us-shan, the Emperor's grandson and successor to Ibrahim Khan, to allow the English to purchase from the existing holders the right of renting from the Nawab the three villages of Sutanati, Calcutta, and Govindpur, extending about three miles along the river and one mile inland. This purchase made the Company the collector, or *zamindar*, and gave them certain rights of levying duties, imposing taxes, and exercising jurisdiction. They paid the Mogul 1,195 rupees a year, and were freed from interference. Thus the town was called Calcutta, and not Sutanati, clearly because the first fort occupied a part of the ground of the village Calcutta. The fort, which dates from 1696, was pushed on, and was called Fort William, after the reigning sovereign, King William III. The British flag was hoisted in Calcutta, on the 6th October, 1703. The size of the fort may be gathered from the length of its sides, viz., 710 feet on the east and west, 485 feet on the south, 340 feet on the north. In the year 1698 a rival to the old East India Company was set up in London by the interlopers, or independent traders; both Companies were represented by Presidents in Bengal. By 1702 the two Companies were amalgamated, and then there were three Councils sitting in Calcutta, that of the old Company, that of the new, and that of the United Trade, as the Head Council. The Government in 1704 bore the curious name of the Rotation Government, which excited some ridicule in India. Under it the two senior members of the United Trade Council were to take it in turns to be Chairman of the Council, week by week. This arrangement lasted until Antony Weltden was sent out as President in 1710. The disputes in the Council were unceasing, perpetual troubles occurred with the native authorities of all grades, it was necessary to bribe to secure the freedom and smooth course of trade, the passage of goods and boats. Ralph Sheldon was the first collector (*zamindar*) of Calcutta, 1700 to 1709. The area under him was 1,861 acres, or less than three square miles, over which he had to collect the revenues: for administrative purposes the Company's land was divided into four quarters. The collector was also magistrate with a police force under him. There was also a native *Dewan* of the *Zamindar;* the famous Govindaram Mitter held the appointment from 1720 to 1751. The regular garrison varied from 129 in 1706, to 200-300 men subsequently, who had also to protect the Company's saltpetre boats and merchandise, piece-goods, raw silk and opium, up and down the river as far as Patna. Under the Rotation Government, 1704-10, the Settlement grew, but without any fixed plan. The fort was not completed, even after 15 to 20 years, but was supposed at the time to be strong enough to

* Vol. I., chap. I., para. 78, page 30.

ward off any attack by the country powers. A Governor's house and other buildings were erected in the fort, a hospital and barracks outside it. A small tank to north-east of the fort, where Dalhousie-square now is, was enlarged, a path was later made round the tank. In 1707, the year of Aurangzeb's death, Calcutta was declared by the East India Company to be a separate Presidency. The Church of St. Anne, thirty yards from the east curtain of the fort was finished and dedicated in 1709; it stood until 1756. For 20 years after its foundation by Charnock, Calcutta advanced by leaps and bounds; the English were enabled by the strength of their position to treat more advantageously with the Nawab: in dealing with an Indian Government, "force and a strong fortification were better than an ambassador." As their numbers increased, the English improved in their conduct and morals, and maintained a higher standard of national behaviour amid Indian surroundings. From contemporary accounts, the social life of Calcutta of 200 years ago can, to some extent, be realised. A majority of the residents were steady and well-ordered, discipline required residence inside the factory walls, daily attendance in Church and at the Company's dinner-table. There were, from earliest days, some English ladies at the Settlement; amusements were few and simple; the place reeked with malaria. In one year, soon after 1706, 460 out of 1,200 English were said to have died between August and January. There are indications that sanitation received some attention from the first, but the funds available were very limited, knowledge and experience had not been gained; people had not learnt how to live and keep their health, and the surroundings were very unfavourable. Though the above figures have not been confirmed, it is certain that the rate of mortality was dreadful; Calcutta was regarded as a place of exile and death. Even up to the end of the 18th century, the European inhabitants used to meet on the 15th November annually to congratulate each other on their escape from the rainy season and the effluvia of the salt lakes.

During the next seven years, 1710-17, there were three Governors; the second of them disregarded the suggestions of the Court of Directors for the improvement of Calcutta, which was left for the next 40 years with a fort which was no fort, as it had "no real strength or power of defence." Murshid Kuli Khan, or Jafar Khan, who gave his name, in 1704, to the city now called Murshidabad, became Nawab of Bengal in 1713, and died in 1725. With him the Calcutta authorities had long and constant negotiations in the interests of the Company's trade. In consequence of this Nawab's oppression and exactions, an embassy under John Sarman, with William Hamilton as doctor, was sent up to Delhi in 1715, to obtain the *firman* of the Emperor Farrukhsiyar, whom Hamilton cured. The embassy was most successful. In 1717 privileges of trade were secured, permission was granted to the English to purchase 38 villages adjacent to the Calcutta Settlement, on both banks of the Hugli, to a distance of ten miles down the river, subject to an annual payment of revenue to the Mogul Emperor. The English were to have the use of the mint. The Nawab declined to carry out these orders fully. He prevented the English from formally acquiring the villages, but, it is said, they acquired possession of them indirectly through their servants and adherents. The Nawab's refusal furnished them with a standing and legitimate grievance, which in Clive's time they were able to urge with effect. Governor Robert Hedges constructed a dock large enough to hold two ships of 400 tons, though it afterwards proved useless. As Calcutta developed, the cost of the Company's establishment rose, so that in 1710-11 it reached nearly 2 lakhs, an increase which annoyed the Court of Directors. Again and again they declared that righteousness is at the root of prosperity. Their letters abounded with directions as to the maintenance of discipline, the study of the languages, the reduction of expenditure, and enquiries into the behaviour of their *employés*.

From 1717 the records of the next 40 years are lamentably deficient, though certain facts are forthcoming. It may be read that a forest existed in 1717 to the southward of Chandpal Ghat. As early as 1727 a Corporation, consisting of a Mayor and nine Aldermen and a Mayor's Court, was constituted. Holwell was for some time its president; it was considered to be too much under the influence of Government, and was superseded by the Supreme Court in 1774; the old Court House was pulled down in 1792, being ruinous; it was for many years the Charity School House, the seat of justice, the scene of many public entertainments, assembly balls, and social gatherings. Between 1727 and 1737 Chowringhi (so-called from Cherangi, the name of one of the 38 villages before mentioned),

though still comprising bamboo groves and paddy fields, and separated from the riparian Govindpur by a tiger-haunted jungle, now replaced by the *maidan*, was being included in the English Settlement. On the 30th September, 1737, a severe cyclone, described in the *Gentleman's Magazine* of 1738, passed over Calcutta, inflicting immense damage on its buildings and shipping; English and native houses and the church steeple were blown down, and twenty-eight vessels sank; the loss of life was enormous; the river rose forty feet higher than usual. By 1738, Burra Bazar and Lal Bazar were in existence. After the Mahratta invasion of Bengal in 1742, the Mahratta ditch was dug, southwards from Chitpur on the north, not as a ring-fence to enclose the Company's lands, but to keep out the Mahratta horsemen; the safety thus provided led to a large influx of the native population into Calcutta. Of the ditch only three miles, out of the seven projected, were finished. During the Mahratta scare, the town proper was completely fenced with palisades. A map of 1742 is extant. Another map of 1753 shows how rapidly houses of all sorts in Calcutta had increased, occupying the ground about the old fort, viz., 600 yards towards the east, and half a mile to the north and south of it. Some of the houses of the Europeans had deep verandas and large compounds attached. One account states that in 1756 there were but 70 houses in the town, the site of the present fort was a jungle, Chowringhi and other parts of the present town were still in the state of rural villages, some of the principal residents had garden-houses out of town, Clive had one at Dumdum. A map, referred to 1760-4, shows only three houses in Chowringhi, south of Park-street; in a map of 1792 Chowringhi is still shown as containing paddy-fields. How useless the defences of Calcutta were appeared from the fighting of 1756-7. The events of that time need only be mentioned briefly. In 1756 Surajuddaula succeeded his old grandfather, Alivardi Khan, as Subadar, that is Nawab of Bengal. European and native historians agree as to his cruel and rapacious character. He was not more than 25, he may have been only 20. He had previously shown dislike to the English; he was offended with them for giving protection to Krishna, or Kishen Das, son of Raf Ballabh Das, *Diwan* of Surajuddaula's uncle, the Chota Nawab. Krishna Das, with his father's valuable property, which it is said Surajaddaula had resolved to plunder, took refuge in Calcutta and the English refused to surrender him when demanded. On this and other pretexts Nawab Surajuddaula approached Calcutta with his force from the north and north-east; attacked, and on the 20th June, 1756, captured the fort, which had fallen into disrepair and was not prepared for a siege; the defenders were few, the militia were inefficient, the garrison and militia together numbered only 514, of whom 174 only were Europeans. The tragedy of the Black Hole was enacted, when only 23 out of 146 English prisoners escaped alive. The name of the town was changed from Calcutta to Alinagar for the few months, until it was retaken on January 2nd, 1757, by Clive and Admiral Watson, with a force from Madras. The Nawab's army was defeated by Clive on the 4th February near Calcutta. The Nawab made overtures, and on the 9th February concluded a treaty with the English, agreeing to the freedom of their trade, to the restoration of their factories, to the fortification of Calcutta, to the establishment of a mint, and signed an offensive and defensive alliance. But nevertheless he assisted the French against the English. The latter joined a confederacy of Surajuddaula's chief officers to dethrone him, and made a treaty with Mir Jafar. Clive marched on Murshidabad, the battle of Plassey was fought on June 23rd, 1757, Surajuddaula fled, and was killed by the order of Mir Jafar's son on July 4th.

From the date of Plassey, which established the English supremacy in Bengal, the growth and prosperity of Calcutta have been continuous. Mir Jafar became Nawab of Bengal, and paid a large sum as restitution money to the European residents and company's servants for the sack of Calcutta by Surajuddaula; with this money commerce revived and houses were rebuilt. Mir Jafar also made grants to the Company, in fee simple, as it has been termed, of land both inside and 600 yards outside the Mahratta ditch, besides *zamindari* lands as far as Kalpi. Thus the area known as the 55 villages, or Panchannogram in the Suburbs, was incorporated in Calcutta. In 1759, by a *firman* from the Mogul Emperor, the revenue which the Company had agreed to pay for the 24 Parganas, amounting to nearly three lakhs a year, was conferred upon Lord Clive as a *jagir*; in 1765, the grant was renewed to him for ten years more, with reversion to the Company in perpetuity. In 1757, and again in 1767, Calcutta was so unhealthy that an order was issued that no troops were to be landed

there. The English proceeded to found a new Fort, also called Fort William, on the site of the Govindpur village, and to erect a new residence for the Governor on the site where the present Government House stands. The deposition of Mir Jafar, the elevation of Mir Kasim, the restoration of the former, the Governments of Clive between 1758 and 1767, the misgovernment during his absence, 1760-5, in England, the fighting in Bèhar, the grant of the *Diwani* (or the civil jurisdiction) belong to the history of Bengal rather than to that of Calcutta. By this time, Calcutta had become virtually, though not in appearance, the Capital of Bengal, the sixth in succession during six centuries; it succeeded to Gaur, Nadia, Rajmahal, Dacca, Murshidabad. As late as 1760, the Government had a chain, or boom, thrown across the river, below Calcutta, to prevent the ships of the Mughs from Chittagong coming up to attack the town. In 1760, there were but few roads in Calcutta, or in the country; none had yet been made along the river side. The early settlers had for many years had no carriages, owing to the want of carriage roads. There were few carriages in Calcutta to the end of the eighteenth century. In spite of the unsavoury sights many resorted to the river for the cooling breeze, bands of music were in attendance. In 1770, the year in which the old Mission Church was built by the Swedish missionary, Kiernander, at a cost of 70,000 rupees, the famine, which carried off a third of the population of Bengal, was severely felt in Calcutta. No less than 70,000 persons are said to have perished in Calcutta in the two months, July to September. The General Hospital was founded in 1769 on its present site. A contemporary writer mentions some of the social habits of Calcutta about 1770, the want of luxuries, the general use of hookas, the white jackets, the riding before daybreak, the office work till two or three o'clock, and then dinner; the tea-drinking, the balls, and the masquerades.

We come now to the historic name of Warren Hastings, who was promoted in 1772 from the Madras Council to be Governor of Bengal, and held that office till 1774. He removed the Exchequer and Treasury from Murshidabad to Calcutta in 1772. Fort William, which had been fifteen years under construction, was finished in 1773 at a cost of two millions. The Governor's official residence was located therein. It was there that Bishop Heber lived temporarily on reaching Calcutta in 1823; the building is now a Garrison Institute. The *maidan* had been cleared, and since 1757 the English residents had migrated more and more from the Settlement near the old fort to the Chowringhi quarter; the old fort was still standing in 1781, when Hodges, the travelling R.A., saw it; it was demolished soon after and public offices were built on its site.

1774—1854.

We may now pass on to the second period, 1774—1854. By the Regulating Act, Lord North's Act of 1773, which made Warren Hastings Governor-General of Fort William in Bengal and gave the Bengal Council control over the other Indian possessions of the East India Company, Calcutta became the Capital of India. From 1774 great progress might have been made in Calcutta if the authorities had only co-operated instead of quarrelling. I do not propose to trouble the audience with a catalogue of the public measures of that time, or even to sketch the arrangements for the administration of Bengal, or the events in other Provinces and parts of India. It is essential to limit our attention to Calcutta and not to exceed the limit except in rare instances. Hastings, as Governor-General, was, as we know, constantly opposed by the three new Councillors from England, Philip Francis, Clavering, and Monson, and supported only by Richard Barwell, the Company's servant, so that, until Monson's death in September, 1776, Hastings was in a minority in Council. We need not linger over the establishment of the Supreme Court in 1774, with Sir Elijah Impey as Chief Justice, or over the trial of Nuncomar (or Nanda Kumar) for forgery, and his execution on August 5th, 1775. The disputes between the Executive Government and the Supreme Court are matters of history; their effects may be traced as reaching to the present day in Calcutta. But it has been observed that owing to these disputes there was general lawlessness in the country, and that the state of Bengal was probably never more lamentable than in the early years after 1774.

In various ways Hastings was specially connected with Calcutta. It was there that, on August 8th, 1777, he married Miss Anna Maria Apollonia Chapusettin, the divorcée Baroness Imhoff; it was there, or rather, near Belvedere, in Alipur, that he fought on August 17th, 1780, his duel with Philip Francis, whom he wounded; there he founded, in 1781, the Calcutta *Madrasa*, or College, for

the Muhammadans, which still flourishes; there he assisted Sir William Jones in founding the Asiatic Society of Bengal; there the Writers'-buildings for the junior servants of the Company were completed by him between 1776 and 1780; and, if his amusements may be mentioned, there he shot tigers in the jungle where the Cathedral now stands. Hodges, the R.A. already mentioned, was in Calcutta in 1781, and wrote of it as a great and opulent city, adding that for its magnificence it was indebted solely to the liberal spirit and excellent taste of Warren Hastings, who raised the first house which deserved the name of a piece of architecture. It was in Hastings's time that Major William Tolly, in 1775-7, opened up communication with the Sundarbans by the channel of the river, the Adiganga, now known as Tolly's nullah, receiving as his remuneration the grant of the tolls for 12 years. He died on his way home in 1784, and Government took over the canal from his widow in 1804.

About 1777 the unhealthy condition of Calcutta became notorious. The judges suffered from fever to the detriment of the judicial work. Hastings showed his appreciation of its climate and pestilential air by maintaining, besides his house in Hastings-street, garden houses at Alipur, Sooksagar, up the river, Birkul, down the river, and Rishra, near Serampur. He remodelled the police of Calcutta, divided the town into 35 wards, and did what he could to cleanse it. The many years that he lived after retirement to England—from February, 1785, to his death, in 1818, at the age of 85—show how little permanent effect the Calcutta climate had on him. But Calcutta was still in 1780 little better than an undrained swamp in the immediate vicinity of malarious jungle. *Dakaiti* and highway robbery were very prevalent close to the seat of Government. At the same time we read of horse-racing on the *maidan* and below Garden Reach on the Akra. It was in January, 1780, that Hickey's *Bengal Gazette*, the first Calcutta newspaper, appeared. Slavery, at one time very common in Calcutta, is shown by the advertisements for runaway slaves to be still in force in 1780; it is said to have continued long into the nineteenth century. A writer, Mackintosh, in his book of travels, dated 1782, condemns the native town in the strongest terms as being offensive in every respect. The English continued to leave the old town of Calcutta for Chowringhi and the Suburbs; more houses were being built, as successive maps show, along "the avenue" to the east, and in the southern or European quarter. By 1823, when Heber saw it, Chowringhi was almost as closely built as Calcutta.

It would be wearisome to examine what each succeeding Governor-General did or did not do for Calcutta. Several of them were absent from it for months and even years, on tours of inspection or other purposes of Government, or engaged in actual fighting. But the development of Calcutta did not stand still in their absence. A few landmarks are prominent in its story, which may be noted. The Church of St. John, the old Cathedral, was begun in 1784, and opened in 1787. Grandprè, who visited Bengal in 1789, praises Calcutta as one of the finest towns in the world. In 1794, when the boundary of the town was first fixed by the Government Proclamation of the 10th September, to be the inner side of the Mahratta ditch, the management of Calcutta was made over to the Justices of the Peace, and a regular assessment was effected in 1795. They attended to the conservancy of the town; its filthy condition was realised, the necessity of very radical measures of improvement was perceived. Education had not been entirely neglected. The old Charity School, founded in 1742, had been destroyed in 1756, and restored in 1757; the Free School was established in December, 1789, and united with the Charity School in April, 1800. Lord Valentia, who was in Calcutta in 1803, repeated Grandprè's encomium of the town, alluding to its size, and to the magnificent buildings in the European quarter. Chowringhi he regarded as an entire village of palaces, the finest he ever beheld in any city. The black town was a complete contrast. He found Calcutta less unhealthy than formerly, owing to better conservancy, greater temperance, and knowledge of disease. Tiffin was at 12, then sleep for two or three hours; dinner between 7 and 8 p m. Lord Wellesley, then Governor-General, had set his face against horse-racing. Few Governor-Generals have done so much for Calcutta as Lord Wellesley effected between 1798 and 1805. He has been called the Augustus of Calcutta. On or near the site of the old Government House, he built the present Government House, which he commenced in February, 1799, completed and occupied in 1803, at a cost of £150,000, besides £5,000 for furnishing, opening it with pomp and

ceremony to celebrate the Peace of Amiens. Heber described it in 1823 as having narrowly missed being a noble structure; its architecture has been described in Fergusson's book; the early pictures and maps show that there were, up to 1825 certainly, no gardens attached to Government House on the south side, as now. Lord Wellesley established in 1800 the College of Fort William, which was reduced by the Court of Directors to a lower standard than he had himself planned for it. He made also the Circular road, partly along the line of the Mahratta ditch, and many minor improvements. His famous Minute of 16th June, 1803, called attention to the requirements of Calcutta, especially in matters of drainage, watercourses, sanitation, building, the regulation of nuisances, its improvement in appearance, and he generally indicated the remedial measures to be adopted. A Town Improvement Committee of thirty members was selected to carry out his scheme, but the improvements advocated by them were not all effected. The practice of raising money for public improvements by means of lotteries came into fashion in 1793. Many important works were executed between 1805 and 1817 with the funds obtained from the lotteries, which were under the immediate patronage of the Governor-General. Large tanks were dug, the Town Hall was built, the Balliaghatta Canal constructed, and several long roads made. The work and funds of the Improvement Committee were transferred to the Lottery Committee, who, between 1817 and 1836, looked after the affairs of the town, except the conservancy, which remained in the hands of the Justices of the Peace. Their efforts were directed to making the Settlement "sweet and wholesome." They introduced street-watering in 1818; made between 1817-21 a number of metalled roadways through the town, and the roads, paths, tanks, and balustrades on the *maidan*. During that period, the Strand road, the Custom House, the Secretaries' walk, St. Andrew's Church were constructed; an ice depôt was contemplated. In June, 1818, the merchants and agents opened a Calcutta Exchange for the accommodation of the mercantile community. In 1818 was launched the *Hastings*, 82 guns, 1,705 tons, the only line-of-battle ship ever built in Calcutta. In 1819 the *Calcutta Journal* was the first daily paper issued in Calcutta, appearing on four of the weekdays. In 1823, the *Diana*, 89 tons, was the first steamer to ply on the Hugli, and from that year public efforts were made to establish steam communication between Calcutta and Great Britain with two vessels of 400 tons each, capable of accommodating 25 passengers, the number of persons leaving Calcutta for England annually being estimated at nearly 500. About 1820, a magistrate, Mr. H. J. Shakespear, pressed the Government to come forward and rescue the inhabitants of its capital from the baneful effects of living in swamps and breathing a polluted atmosphere. In 1833-4 Calcutta Trade was seriously affected by the disasters which befell a large number of the agency houses through over-speculation. When the Lottery Committee came to an end in 1836, public opinion in England having condemned this method of raising funds for municipal purposes, Lord Auckland appointed a Fever Hospital Committee, which enquired thoroughly into and exposed the insanitary state of Calcutta, though again the results were incommensurate with the inquiry. Municipal administration of a kind in Calcutta dates from 1840. For many years, in fact before the time of Holwell in 1752, the Collector had been the administrator of the town and suburbs, with very considerable powers, but he had too much on his hands, little experience had been gained, and he was badly served. The first scheme of self-government, proposed by the Chief Magistrate, Mr. D. McFarlan, in 1833, was experimentally tried in one division of the town, but without success. The Fever Hospital Committee of 1836, in their report of 1840, made recommendations in favour of municipal self-government which bore little fruit. In 1840 the town was divided into four portions, and the Government was empowered by law to establish certain municipal administration on the application of two-thirds of the ratepayers, but no such application was ever made. A writer in 1846 could still say that Calcutta was then, as of old, the most unhealthy City of Palaces in the world. Then followed experiments, in 1847, with a Board of seven Commissioners for the improvement of the town, reduced to four in 1852. In 1848 conservancy functions were withdrawn from the Justices of the Peace and transferred to the Board of Commissioners. The police arrangements and division of the town, as made in 1785, endured under a Superintendent appointed in 1808, until 1845, when the Calcutta Police Force was thoroughly reorganised. These were the latest developments in Calcutta administration when, on Lord Dalhousie's

initiative, a Lieutenant-Governor was appointed for Bengal from the 1st May, 1854, and the Governor-General (who had in Lord William Bentinck's time in 1834 become Governor-General of India, and Governor of Bengal instead of being Governor-General of Bengal), ceased to be Governor of Bengal, and ceased, therefore, to have the immediate and direct power over Calcutta. The Lieutenant-Governor thus became, as the head of the Local Government, responsible to the Governor-General in Council for the administration of Calcutta. A suitable residence was purchased and furnished for him at Belvedere, in Alipur, just three miles from Government House.

1854-1906.

The appointment of a Lieutenant-Governor is a suitable point from which to make another division of the history of Calcutta. In fact, modern Calcutta, though it has elsewhere been dated from 1757, may be said more correctly to commence from this date, 1854. I do not mean to assert that, before the creation of a Lieutenant-Governorship, there was no proper administration of Calcutta, or that everything was changed by it, or that it was the sole cause of the modernisation of Calcutta. Changes in so large an area occur gradually, and various causes combine in producing an effect. Among the contributory causes the first place must, I think, be assigned to the improvement of communications with England and the interior of India. The development of the steamer service with England, the opening of 120 miles of the E. I. Railway to Raniganj on the 3rd February, 1855, and its subsequent extension to the Upper Provinces would necessarily increase the Trade of Calcutta. Apart from the E. I. Railway, and the improvement of the Port and Canals to the Sundarbans, Lord Dalhousie appears (from his farewell Minute of 28th February, 1856) to have done very little for Calcutta. He established a Civil Engineering College, and had under consideration a scheme for bridging the Hugli, but no special acts on his part are recorded. More roads were made into the interior of the country, such as those to Darjeeling and Jessore. The Sepoy mutiny of 1857-8 was felt in Calcutta, owing to the proximity of Barrackpore, where mutinous symptoms first occurred. The Legislature passed an Act which lasted for a year to control the Press in Calcutta. The Calcutta Volunteers were enrolled. The feeling of alarm in Calcutta culminated on the so-called Panic Sunday, the 14th June, which has been described by the historians of the Mutiny. The panic has been declared to have been groundless and unreasonable, but people of different classes are said to have sought refuge in Fort William and on board the ships in the Port. I had always understood that Panic Sunday was a historic fact, but in the discussion on Mr. Skrine's paper above mentioned the Chairman, Sir Steuart Bayley, stated that, though he was in Calcutta at the time, he was absolutely ignorant of the whole affair until some time afterwards. Apparently some of the poorer Europeans and Eurasians of the suburbs sought refuge in the fort and ships, but the Chairman denied the occurrence of the panic as narrated. I cannot pretend to decide between the writers of history and an officer who was present at the time. After the Mutiny of 1857-8 a change came over the whole of India, including Calcutta. The assumption in 1858 of the Government of India by the Crown brought closer the relations between England and its great Dependency. Greater security led to the introduction of more capital. The progress of the town may be regarded from a municipal and from a commercial point of view. In 1856 a Commissioner of Police had been appointed. In 1856 an elaborate Municipal Act had been passed for Calcutta, under which three Commissioners were appointed. Work was commenced in 1859 on Mr. Clark's scheme of 1855 for the drainage and sewerage of Calcutta by a system of underground sewers leading towards the salt-water lake on the east. It was extended in 1872 to the northern, *i.e.*, the native, part of Calcutta and eventually completed. This scheme cost over 95 lakhs of rupees. The town was thus made drier and cleaner, an immense gain alike to comfort and health. A well-informed authority wrote in 1860 of Calcutta as being, with regard to internal and external improvements, half a century behind the spirit and requirements of the age :—he added, "If we consider the political, financial, and commercial importance of this city, it must be obvious that it ought to be in the interest of all parties, the governing and the governed, to metamorphose Calcutta as rapidly as possible into a town which, through the amelioration of its sanitary condition, would render the health and life of European settlers more secure, and, by the introduction of measures for facilitating commerce, be the most infallible means of largely developing not only

the trade of the city, but that of Bengal, the City of Palaces being the great export and import mart of this Province." The writer's ideal was a high one—that Calcutta ought to be to the East what London is with regard to the commerce of the world; and he indicated the lines which improvements should take to meet the sanitary, commercial, and political requirements of the city. By persistent pressure some of the structural improvements then foreshadowed have been attained. But complaints against municipal adminstration have always been rife in Calcutta. They led in 1861 to a Commission of inquiry which resulted finally, in 1863, in a new municipal Act, the first of the kind passed by the Bengal Legislative Council, sitting in Calcutta; this Act vested the municipal government of the town in the Justices of the Peace. The insanitary state of Calcutta attracted the attention of the highest authorities. Sir John Lawrence went to Calcutta as Viceroy in January, 1864. To stimulate his recollection of the insanitary condition of Indian cities he would direct his morning rides (so wrote his quondam Secretary, who himself took similar rides 10 to 12 years later) to the unhealthiest parts of Calcutta, and one of his first measures was to appoint a Sanitary Commission. The climate of Calcutta agreed with him less than that of any other place in India; he said explicitly that he found himself unable to work all the year round at Calcutta, and especially in the hot and unhealthy season there. It was he who first commenced the system of moving the whole of the Government of India annually from Calcutta to Simla. But he objected to all schemes involving the abandonment of Calcutta as the Capital of India, considering them to be crude. "In the first place, such a move would be inordinately expensive; in the second, Calcutta was, he thought, the best of all available positions. Though it is actually a seaport yet its position is by nature rendered unassailable by an attack from the sea; its trade places it in the first rank of mercantile cities; the districts around it are wealthy, fertile, populous, and peaceful. These advantages he duly appreciated." So he adhered to Calcutta as the site of the Capital of India, as the proper place for legislation on matters wherein contact with public opinion might be specially desirable. This principle is still observed. Sir John Strachey, as President of the Sanitary Commission just mentioned, wrote in March, 1864, of the state of the Capital of British India, one of the greatest and wealthiest cities in the world, as a scandal and a disgrace to a civilised Government. On his recommendation the offices of Chairman of the Justices and the Commissioner of Police were combined in the same officer. It is a question, to my mind, whether the separation of the two offices in later years was not a mistake. The municipal constitution was again changed by the Bengal Act of 1876, when the number of the Municipal Commissioners was fixed at 72, that is 48 to be elected by the ratepayers, and the remaining 24 nominated by the Lieutenant-Governor. This Act obviously gave the voting power to a majority who were, it may be said generally, adverse to improved municipal administration at the cost of the community. Complaints against that administration culminated again in 1884, leading up to another Commission of inquiry and the formation of a Health Society. After prolonged agitation, the Municipal Consolidation Act of 1888 was passed, which added a considerable part of the Suburbs to the town, thereby increasing the wards from 18 to 25, and substantially improved the law. The number of the Commissioners was raised to 75, that is, 50 elected by the ratepayers, 15 nominated by Government, and 10 elected by non-official commercial bodies. The Act of 1888 did not attain all its objects. A Building Committee was appointed and reported. This led up to the Calcutta Municipal Act of 1899, which reduced the number of Municipal Commissioners from 75 to 50, 25 of the latter to be elected by the ratepayers, 15 nominated by Government, and 10 elected by the commercial bodies. Much power was vested in a General Committee of 12 members, partly elected, partly nominated, so that there are now three co-ordinate authorities—the Chairman, the General Committee, and the Corporation as a whole. To enumerate the improvements effected by the Calcutta municipal authorities under the various Acts during the fifty years from 1856 to 1906 would occupy too much time and space. The filtered water-supply scheme sanctioned in 1865 was completed in 1870 in the face of tremendous opposition on the part of the natives. They declared that it would be contrary to their religious principles to drink water conducted through metal pipes. When they discovered the excellence of the water and the convenience of having it available at a neighbouring standpost, or hydrant, they soon found other texts in their *shastras* which admitted of their drinking such water. No

single improvement has done so much as this to place Calcutta on a level with the great cities of Europe and America. Isolated cases of cholera occur, but within 21 years from the introduction of the filtered water-supply the mortality from this dread disease fell to one-fourth of its former standard, and has since ceased to figure so prominently amongst the causes of mortality in Calcutta. The quantity of filtered water conveyed all the way by a covered aqueduct from the intake at Pulta above Barrackpore, 16 miles from Calcutta, has been more than once increased, and the supply is again being extended. The native cry is now for more of this water at greater pressure. The natives have, chiefly in consequence of this filtered water and the improved drainage, for some time past regarded Calcutta as a sanitarium. It is now acknowledged, says one writer, to be the healthiest place in Bengal; perhaps that is not saying much.

On the 6th July, 1859, Chowringhi was for the first time illuminated with gas. About that time, and since, the Strand Bank has been made up and ground has been reclaimed from the river. The establishment of a first-rate European market was carried out in the early seventies. In 1874, Calcutta was at last, after the abandonment of various projects, connected with Howrah by Sir Bradford Leslie's floating bridge, 1,530 feet in length, which was only expected to last 25 years, but is still in good working order. It was in 1876, when Dr. A. J. Payne became the Health Officer of Calcutta, that, during his incumbency and at his instance, the first real steps were taken towards the improvement of the sanitary condition of the town. Attempts have been continuously made to remove the old reproach that native Calcutta was a city of filth, while European Calcutta was a City of Palaces. During the 50 years under review large sums have necessarily been spent upon roads, drainage, conservancy, the demolition of *bastis*, or collections of huts. Markets, workshops, squares, gardens, have been constructed; electric tramways and electric lighting have been introduced. Numerous bathing places have been provided, and the bathing-ghats improved. The municipal revenue and expenditure are inincreasing every year. The revenue funds during the year ending March 31st, 1905, amounted to Rs.67,29,859, and the expenditure to Rs.65,23,951. The total receipts amounted to Rs.102,71,847, and the total expenditure to Rs.89,73,054. The gross assessed valuation of the town on that date was Rs.2,68,02,321, an increase of 13½ lakhs during the year. In 20 years the valuation of the town was nearly doubled. On the same date the total debt of the Corporation amounted to Rs.3,75,49,464. I mention these figures to give some idea of the magnitude of the town and its municipal work. Under a reorganisation scheme the town has been divided into four districts, in the hope that decentralisation will produce better results.

A large scheme for the improvement of Calcutta has been under consideration since a sanitary survey of the town, conducted in 1896, called prominent attention to the overcrowding of the northern portion. The provisional scheme contemplates an expenditure of 8¼ crores of rupees on (1) making new broad roads; (2) providing open spaces; (3) acquiring land for expansion; (4) improvements, to be carried out by a Trust, in 20 years, the cost to be met by recoupment and recoveries from frontage owners, by a Government grant, and by special taxation. After preliminary confidential discussion the scheme is now before the public for consideration, especially with regard to the form to be taken by the special taxation required. This is not the occasion for going into further details on the subject. It is satisfactory that at last, in consequence of pressure applied by Government, some effort is being made on a large scale to improve Calcutta, especially the native quarter.

Sir Charles Stevens's paper on the Port of Calcutta, already mentioned, relieves me of the task of dwelling at any length on the Trade of Calcutta. So long ago as Lord Dalhousie's time, 1848-56, the tonnage of the ships which sought Calcutta in trade more than doubled during his eight years of office. The latest figures that I have been able to obtain, up to the 31st March, 1905, show the importance to which it has attained. The volume of the Trade of the Port has reached a total of Rs.133,75,54,397; divided into foreign trade, Rs.94,58,44,385; coasting trade, Rs. 11,60,58,664; inland vessels, Rs.27,56,51,348, of which total Rs.59,84,71,102 were imports, and the exports were Rs.73,90,83,295. From the docks, 3,326,370 tons of produce were exported in 1904-5. The ships (other than inland vessels) entering the Port numbered 1,367, divided into coasting vessels, 860; other seagoing vessels, 507. Their registered tonnage amounted to a total of 3,132,523 tons. Two-

hundred and fifty-nine vessels, with an average tonnage of nearly 3,500 tons, were accommodated at the import jetties.

The capital debt of the Port Trust amounted on the same date to Rs.4,98,10,320; the Trust has spent a total of over six crores on works. Their receipts in 1904-5 were Rs.89,73,628, their expenditure was Rs.82,32,154. They have lately applied for a loan of over 83 lakhs, to carry out further works for the development of the Port. During the last 50 years Howrah and Calcutta have become the termini for six railways, namely the East Indian, the Bengal and Nagpur, the East Coast, the Eastern Bengal, the Central Bengal, and the Bengal and North Western, besides a number of branches and feeder lines on special gauges. The Canals round Calcutta also bring in large quantities of local produce. The factories and mills in Calcutta and the suburbs have become so numerous that the abatement of the smoke nuisance has become a serious question. It would not be easy to suggest any method by which the commercial interests of Calcutta could obtain further recognition than they receive at the present time. For their protection and development there are the Bengal Chamber of Commerce, the Bengal National Chamber of Commerce, the Calcutta Trades' Association, the Royal Exchange, and a Marwaris' Association. There are the Commissioners of the Port of Calcutta, ready and keen to afford every facility; and last, but not least, there is the newly constituted Member of the Supreme Council in charge of Commerce. As Calcutta was founded more than 200 years ago for purposes of Trade, so is Trade still the main factor of its existence and increase. It has been said that, in the absence of a convulsion of Nature, no limit can be seen to the destinies of the Trade of Calcutta. Were it not for this Trade, and all the consequences entailed thereby, it is quite conceivable that the question of the site of the Capital of India might at any time be reopened. But under the present circumstances of the Trade, and having regard to its probable growth in the future, the idea of transferring the seat of the Capital does not come within the range of practical politics. Whether Trade follows the flag or precedes it, so long as the Calcutta Trade is there the flag must there be hoisted and there have its head-quarters.

Population.

I have purposely postponed to this point all allusions to the numerical increase in the population of Calcutta, and have done so even at the risk of appearing to be obliged to go back to periods of its history from which we have passed onwards. But the bare figures of the population would have conveyed little meaning without some previous explanation of the circumstances under which they were attained. Without some knowledge of the history, the administration, the municipal and commercial development of the town, the figures would hardly have been intelligible. For earlier times, before the days of scientific enumeration, the available figures of the population cannot be regarded as certain, sometimes they are avowed estimates, the areas referred to constantly differ. I can only reproduce the calculations of the population of Calcutta at various times as given by the best authorities. The variations in the superficial area of the town must be borne in mind. Its urban area of 215 acres in 1706 (*i.e.*, 16 years after its foundation) had increased to 704 acres in 1756 (the year of its siege and capture), and to 3,714 acres in 1794 (before Lord Wellesley arrived in India), and to 3,754 acres in 1876. The inclusion of the Suburbs, *i.e.*, the "added area," into the town in 1888 led to the extension to 11,850 acres of the urban area which stood at the census of 1901 at 11,954 acres, or 18½ square miles. The total area of the town proper, including its rural tracts (but not the Suburbs), has increased from 1,692 acres (*i.e.*, 2½ square miles) in 1706 to treble that size in 1794, to 5,037 acres (*i.e.*, a little under 8 square miles) in 1876, and to 13,237 acres (*i.e.*, 20⅔ square miles) in 1901.

The late Dr. C. R. Wilson, of the Bengal Education Department, whose death last year is greatly to be deplored, carefully examined the question of the early population of Calcutta. Captain Alexander Hamilton, the independent merchant previously mentioned, estimated the population in 1710 as between 10,000 and 12,000. Dr. Wilson calculated that, during the Rotation Government of 1704-10, the population of the Company's land rose from 15,000 to 41,000. In 1752 Holwell, then Collector of Calcutta, and afterwards the principal survivor and historian of the Black Hole tragedy, by including a large area which did not then form part of Calcutta, estimated the total number of the population at over 409,000. This estimate has since been regarded as open to great doubt. Dr. Wilson reduced it to 105,000 for the English area, and to double that figure for the whole area. Having regard to the increases in the urban

and total areas between 1706 and 1752, it is more than probable that Holwell made some mistake in his calculations. There were severe famines in Bengal in 1752, 1762, 1770, and a serious epidemic in 1757. Holwell, in 1752, writes of "walking skeletons" in the streets, and of parents selling their children for a rupee apiece. To the famine of 1770 I have already alluded. Thus the estimates, ranging from 500,000 to 700,000, formed by various persons, for the population of the total area between 1796 and 1814 seem to be mere guesses at the day population of the town. Later figures are more likely to have been approximately correct, as having been ascertained by official agency. The four assessors appointed in 1821 returned the population at nearly 180,000. Captain Steel in 1831 gave it as over 187,000; a census of 1866 showed a population of 359,000, a lower number than in 1850; the population of the same area had increased in number to about 409,000 in 1876. Other enumerations were made in 1850 and 1872, but their accuracy was subsequently impugned. More trustworthy figures have been obtained in the last three enumerations of 1881, 1891, and 1901. It is easy to become confused among the varying areas which have come under the census operations from time to time. But some main points may be seized. The same area that contained about 180,000 inhabitants in 1821 contained about 409,000 in 1876, and 400,000 in 1881, and 544,000 in 1901. The total figures are the most important. Calcutta, under the Corporation and including Fort William, numbers nearly 848,000; but adding in the Port, the Canals, and the three suburban municipalities of Cossipur-Chitpur, Manicktolla, and Garden Reach, it increased from 648,000 inhabitants in 1881 to 765,000 in 1891, and 949,000 in 1901. If to these figures are added the inhabitants of Howrah on the west bank of the river, viz., 105,206 in 1881, and nearly 158,000 in 1901, the aggregate population of the Metropolis of India in its largest dimensions amounted in 1881 to 790,286 persons, when Calcutta was already the second largest city in the Empire, and in 1901 to 1,107,000 persons, thus being one of the twelve largest cities in the world. Its population is said to be exceeded only by London, Constantinople, Paris, and Berlin in Europe; by New York, Chicago, and Philadelphia in America; by Tokio in Japan, and certain cities in China. Of the 949,000 persons in Calcutta and the Suburbs, the Hindus form nearly 65 per cent., the Muhammadans nearly 30 per cent., and the Christians rather over 4 per cent. Several other religions are represented. Of the 38,515 Christians, 8,490 are English. But many other nations have their representatives in Calcutta, as the Census reports show. The town has been described as a *colluvies gentium;* the policy of the open door has prevailed since the prohibitions against interlopers and missionaries were withdrawn. The rate of increase of the town of Calcutta is very high, viz., 34 per cent. since (the untrustworthy figures of) 1872, and 24 per cent. as compared with 1891. The increase of Howrah is even more remarkable. When I personally took the Census in that municipality in 1881, the number of the people was 105,206. The increase to 158,000 there has therefore been a little under 50 per cent. in twenty years. I have troubled you, I fear, with too many figures, but, after all, they form the basis on which statisticians calculate the growth of towns and by which the comparative greatness of the principal towns of the world is measured.

Later Events.

It will interest the audience more, I think, to hear something of the events which have occurred at Calcutta during the modern period of its history. I have no intention of giving lists or lives of the many persons who have distinguished themselves in Calcutta; nor do I propose to give a *résumé* of the chief official measures of the last 50 years, though they were, in one sense, important, and emanated from Calcutta. It is necessary to concentrate our attention strictly on the town of Calcutta. In doing so, I cannot omit to mention the foundation of the Calcutta University in 1857, an Institution which has largely dominated the Education of the country on lines considered to be so erroneous as to require its reconstitution by a recent Act of the Legislature. The Proclamation of the assumption of the Government of India by the Crown was read by the Home Secretary, Cecil Beadon, from the steps on the north side of Government-house, on the 1st November, 1858. It was in Calcutta that the excitement connected with the indigo disturbances of 1860-1 came to a head in the *Nil Darpan* case, the Bengali drama on the subject of indigo cultivation, which led to a prosecution in the Supreme Court for libel, and to the punishment of certain persons connected with the translation. About that time the Calcutta Rifle Corps, of some 160 strong, was formed. The Bengal Legislative Council, which sits in Calcutta

very near, if not on, the site of the old Church of St. Anne, destroyed in 1756, dates from 1862; the High Court which amalgamated the old Supreme and *Sadr* Courts, from the same year. Calcutta suffered severely from the hurricanes of October 5th, 1864, and the 1st and 2nd November, 1867. The liability of Calcutta to cyclonic storms is a chronic danger. It luckily escaped the cyclones of 15th and 16th October, 1874, and 31st October, 1876, which passed at no great distance. The effects of the Orissa famine of 1866 were felt in Calcutta, whither the starvelings crawled in numbers, and were picked up dead or dying by the police. Calcutta has had opportunities of demonstrating its loyalty to the British Crown on the occasions of the visits of H.R.H., the Duke of Edinburgh in December, 1869—January, 1870, of His Majesty the present King-Emperor, as Prince of Wales, in December, 1875, and of H.R.H., the late Prince Albert Victor, in January, 1890. It has lately vied with the rest of India in according a most hearty welcome to their Royal Highnesses the Prince and Princess of Wales. On such occasions the native community have always co-operated cordially with the Europeans in their expressions of loyalty to the Royal Family of England. The Cesarevitch, now His Imperial Majesty the Tsar of Russia, was received in Calcutta with fitting honours and ceremony in January, 1891. But Calcutta has been stirred by sad occurrences as well as by its occasions of rejoicing. The murder of the officiating Chief Justice, J. P. Norman, on the 20th September, 1871, as he was ascending the steps of the Town Hall on his way to his Court there, struck a thrill of horror through the whole community, which was intensified by the subsequent assassination of the Viceroy, Lord Mayo, at the Andamans on the 8th February, 1872. The latter's funeral procession, and the funeral service on the north steps of Government-house were the most melancholy sights ever witnessed there since the tragedy of the Black Hole. Excitement never reached a higher pitch in modern Calcutta than at the time of the Ilbert Bill in 1883-4, the project of law brought forward by the Government for the purpose of enabling certain native magistrates to be invested with powers over European British subjects The public meeting of the European community of Calcutta at the Town-hall on the 28th February, 1883, will never be forgotten. An International Exhibition was held in Calcutta in 1883-4. On the 16th February, 1887, the Jubilee of the late Queen-Empress Victoria was celebrated in Calcutta with the greatest enthusiasm. In 1892 the Bengal Legislative Council was enlarged, and the members of the Council were given the rights of interpellation and of criticising the annual financial statement of the Local Government. An inquiry into the working of the jury system in Bengal, ordered by the Government of India in May, 1890, produced considerable political excitement in Calcutta, in 1892-3, and practically resulted in the continuance of the system with slight modifications. On the occurrence of plague in Bombay towards the end of 1896 every precaution possible was taken to prevent its importation into Calcutta. No case occurred in 1896-7, but shortly after the year 1897-8 closed there was a sporadic outbreak in Calcutta; panic and an exodus of the inhabitants ensued. The measures since adopted have failed to eradicate plague; every year it has returned with remarkable periodicity in the hot weather months, but has never gained such a hold of the town as in other parts of India. The earthquake of 12th June, 1897, did much damage to the buildings in Calcutta, but as it occurred at 5 p.m. no lives were lost. Serious riots occurred at Chitpur and in the northern parts of Calcutta, on 30th June and 1st July, 1897, in connection with a piece of land alleged to contain a mosque. The inflammable nature of the people was clearly manifested on this occasion. Their emotional nature was exhibited on receipt of the news of the death of Queen Victoria in January, 1901. The people of Calcutta desired to meet on the *maidan* to demonstrate their grief. It devolved on me personally to advise, notwithstanding some misgivings of the police authorities, that the meeting should be allowed. Dense crowds assembled near the Ochterlony monument; the people turned out in myriads from their ancestral mansions and their primitive hovels. The common sentiment of the vast concourse was unmistakably one of sincere sympathy and respectful loyalty to the Crown. Their conduct was unexceptionable—it was a great and moving sight, the simple expression of the loyal grief of the masses in the Capital of India. The last excitement which I can remember personally in Calcutta was that which arose in the cold weather of 1902-3, in opposition to the proposal to place the Victoria Memorial Hall on an admirable site on the *maidan* between the Fort and the Red-road. The agitation was successful, as agitations constantly have

been in Calcutta. Those concerned with the selection of a site decided to adopt another, to which no exception was taken. The partition of Bengal has evidently, according to the newspapers, aroused great feeling in Calcutta; but this subject has recently been fully described to this Society. It may be thought that I have mentioned but few incidents, and those of little importance, of the last 50 years. The fact is that the life of a town in India is ordinarily monotonous, varied by climatic occurrences, ebullitions of feeling, and political disturbances. The people pursue their avocations, the clockwork of trade, business, official life, military exercises, goes on hardly noticed; one high authority rules for his brief span, is succeeded by another, and retires into obscurity. Small matters must be chronicled, for there is little else to record.

Observations.

But some characteristics of Calcutta remain the same, to which I may briefly allude. It is still the Capital of India. It has been described to me as a place marked out by nature for a Capital, emphasised by railways. It is still an excellent trade centre, and Trade continues to increase, though Chittagong may prove a rival Port for the export of tea and jute. The insanitary condition of Calcutta has been a cry for 200 years, and, under the circumstances of the locality, and of the people, is likely to remain a cry for a long time to come. If it is as healthy as many a Continental Capital, that fact does not indicate a standard of sanitation with which English people should be content. The absence of the adjutant birds, which were greatly in evidence 35 to 30 years ago, indicates improved sanitation, but it does not prove that the sanitary administration of the town is yet perfect. Calcutta, again, is a centre of political organisations. There is no need to discuss the causes; whether this is the fault of the Government, or the outcome of the Bengali character, or of the teaching of the Education Department, the fact remains. It is openly said, nay, printed, that with all the good intentions of the English rulers the benefit that has actually arisen to the people of the country is not an unmixed one. Racial feeling is never absent from Calcutta. It is impossible to assert that friendly relations exist between the different races, as has been claimed to be characteristic of Madras. The struggle of the educated classes to obtain a larger share of the loaves and fishes, in the shape of official appointments, never ceases. Social intercourse between the Europeans and natives makes but little progress. There is greater toleration of differences of thought, customs, manners, religion, but mutual understanding has made little real advance. The ignorance of the native languages on the part of many Europeans is much to be regretted. The natives continue to regard all force with abhorrence; they equally dislike the British soldier, the policeman, or any personal vigour and energy. They look to the High Court and the Law as their protectors, against the Executive Government. Thus the opposition of the Supreme Court to the Government in the time of Warren Hastings has never escaped their memory. The natives have seen European agitation successful, and have improved upon European methods. The whole population is easily stirred. It is easy to manufacture a kind of public opinion, and to attach an importance to matters of little real moment. The meeting places of various sections of the community, the Clubs, the Bar Library, the business quarters, the Associations, the bazars, the daily newspapers, admit of the rapid dissemination of views, correct or erroneous; it is easy and cheap patriotism to criticise the Government and its officers, or to seek notoriety by abusing a municipal administration, dependent often on unsatisfactory subordinates.

The net result is that Calcutta is in many ways a difficult town for the Government to govern, and for the municipal authorities to administer. I have often thought that the separation, in the late eighties, of the offices of Chairman of the Corporation and Commissioner of Police, which had been combined for about 25 years, was a mistake. The separation may have been desirable at the time, but should not have been continued. If Calcutta is to be better administered, improvement can best be effected by increasing the power of the highest executive authority, not by extending it over a larger area, not by including Howrah, for instance. I do not suggest that discussion should be precluded, but I do maintain that the executive requires strengthening. The wonder is that the administration makes any progress at all, and, if the town is to develop further, as it shows every sign of doing, especially in the southern direction, if the requirements of modern civilisation are to be met, as English opinion very properly demands, very properly, I say, having regard to the interests of Trade and to the amount of English Capital

invested and seeking investment in the country, then some means should be found for making the administration of the town more rapidly effective. The proper course in my opinion, formed on the observation of 35 years, is to make the Chairman of the Corporation a Chief Commissioner, with police powers, and to allow him as many Deputy Commissioners for municipal, police, secretariat work, as are required for efficiency. As he is held responsible he ought to have more power, and under him officers on whom he can rely.

As Calcutta progresses, I anticipate that some such development of the municipal administration will be found inevitable, and be demanded; greater efficiency in the administration should accompany the extension of the town. I would go further, and should be glad to see a Commission sent out by the Secretary of State to enquire into the state of Calcutta, its administration, and the requirements for its improvement and extension. Calcutta, says the native writer from whom I have already quoted, is to-day as much a European as a Bengali and Marwari town. He is perfectly right. Calcutta is not really India. They know not India who only Calcutta know. Calcutta has been made by European, chiefly British Trade, by British enterprise; it would have made much greater advance had the British had their own way entirely. I should like to see an independent Commission from England, not to supersede, but to strengthen the hands of, the local authorities, who are loath to incur the imputation of being hostile to Local Self-Government. I am not opposed to such Local Self-Government as facilitates work and progress. Calcutta has extended, and been improved to some degree, in spite of Local Self-Government, under immense friction. By far the best administration in Calcutta is that of the Port Trust, where the Commissioners have a common object, to provide facilities for the growing Trade of the Port. If the Municipal Commissioners of Calcutta had had such a common desire to improve Calcutta, very different results would have been attained by this time. A Commission of persons eminent in Commerce and Administration is, in my opinion, wanted, to indicate independently and honestly, without any question of fearing or favouring Local Self-Government, what is required under different heads to assist Calcutta in the improvement, increase and expansion which are taking place and will continue, as facilities are afforded.

There are various portions of my subject on which, for want of time and space, I am prevented from touching. I should have liked to give some account of the Education of the town, to mention some of the principal educational institutions, such as the Hindu College, founded in 1817, Bishop's College in 1820, the Sanskrit College in 1824, St Xavier's College 1834, La Martinière in 1836, the Medical College, and the Missionary and Scotch Church Institutions, and to say something of the great controversy between the advocates of the Oriental and English languages, closed by Lord Macaulay's Minute of 1835. I should have liked to give some sketch of the Press in Calcutta, and to allude to the difficult question of the poorer Indo-Europeans in Calcutta (which was thoroughly investigated by the Pauperism Committee of 1892), to tell of the extensive charities of the town, and of various other matters. It would take a volume to deal adequately with all these points. I had hoped, too, to describe the social life of the English in Calcutta at the present day. But there is little to say about it that is not perfectly well known. Social habits naturally change from time to time; for instance, old Calcutta paid no visits between 11 a.m. and 2 p.m., it was deemed unhealthy to do so, formal visits were paid in the evening; when the dinner hour was changed, about 1800, to sunset, visiting was changed to the forenoon; now the tendency is to revert to the old custom of evening calling. A palanquin is hardly ever seen: motor-cars are superseding carriages. Calcutta hospitality is proverbial; this has often been remarked by English visitors. The amusements of Society vary in Calcutta, as elsewhere, according to the season of the year. In its social aspects, Calcutta in the cold-weather season is one place, and Calcutta from early April to November is quite another place; some prefer the comparative quiet of the longer period. The fall in the value of the rupee within the last 35 years has been severely felt by all classes in Calcutta. The increased demand for house accommodation, partly caused by the increased number of European residents, partly by wealthy native gentlemen coming to reside in the European quarter of Calcutta and the consequent rise in house-rent, have led to many residents contenting themselves with inferior houses or living in flats. The increase in the rates of the wages of servants may be seen by comparing with the old lists of 1759 and 1801, which

are available. In every respect the cost of living has gone up in Calcutta. On the other hand, the necessities of existence in a tropical climate have greatly improved within living memory. The filtered water, unlimited ice, electric punkahs, the excellent markets, the good shops, make life much more bearable in Calcutta than in olden times, while relief from the climate is much more easily obtainable than formerly, through the improved communications with hill-stations.

Conclusion.

Notwithstanding its growth in size, the improvements effected, and the prospects of further expansion, one sometimes sees the question discussed whether Calcutta will always maintain the position that it has gained. Sir W. W. Hunter said of it, *sedet æternumque sedebit*, but it is rash to prophesy anywhere, especially in the East. The dangers of attack by land or by water may be provided against by human forethought; Science may minimise the danger of a storm-wave coming up the river; scientific engineering may go far to ensure the inflow of water from the Ganges down the Bhagirathi to the Hugli; the buildings may be constructed in the strongest style; but who shall contend against the forces of Nature? In the East rivers desert their channels, ruinous cyclones and earthquakes occur, pestilence has devastated flourishing localities, the variation of trade routes has affected the destinies of great cities—history shows that Bengal has had several Capitals before Calcutta—who then shall say of Calcutta that it will abide for ever? All that can be done is to continue the strenuous efforts adopted to keep open the course of the river both above and below Calcutta, to make the city as safe as human skill can devise, and to commend its safety to Providence, under whom it has risen from the condition of three small villages to the position of the Capital of the Indian Empire. In one respect, however, no change can, humanly speaking, be effected. The climate cannot be changed, though its effects may be mitigated. It is the climate, after all, that settles the question of life in Calcutta for each individual. If he, or she, can stand the climate, enjoy some of the amenities of life, and keep health, there are few places where people who have to work or are expatriated can have a better time. Many who have left Calcutta can look back to years spent there, in spite of the climate and of separation from home ties, in happiness and comparative comfort, to hard work performed in the service of the State or in the acquisition of an honourable livelihood, to having taken a share, however small, in the development of the Indian Empire.

DISCUSSION.

Mr. S. M. Mitra said that as a Bengali he was proud of Calcutta, the London of the East. He was, therefore, delighted that the author of the paper was a gentleman whose name was a household word in Bengal, and was an authority on Calcutta. Mr. Buckland had referred to Fort William. No account of Calcutta was complete without a reference to Fort William. He did not mean the fort in a military sense, he did not refer to its parades and sham fights, but he meant the Fort William College, the pioneer of education and modern civilisation in India. In 1800 the Marquis Wellesley founded the Fort William College. It was under the patronage of the Fort William College that Dr. Carey published the first dictionary of the Bengali language. It was at the instance of the Fort William College that the Countess of Loudon founded and endowed the first Bengali girls' school. It was the Fort William College which inspired Lady Amherst to take an interest in the female education in Bengal. The Battle of Plassey was no doubt a decisive battle, but Fort William had fought greater battles—bloodless battles. From inside its ramparts a start was made to fight the great social and moral battles, which had imperceptibly shifted the centre of gravity of Hindu life in Calcutta. All the wisdom of the Greeks, all the learning of the Germans, could not have created such an atmosphere of pure and elevated sentiment which one found nowadays in really educated and refined Bengali society in Calcutta. So, Fort William was of more than ordinary interest to Calcutta, and perhaps, therefore, the most important of all edifices in the City of Palaces. The Fort guaranteed Calcutta's peace, the College inside drew all Bengal to a focus by developing its literature, by encouraging its Pundits. The great Pundit Vidyasagara, the father of the modern Bengali language, owed a great deal to the Fort William College. It was while working in the Fort William College that the great Pundit received his inspiration to remodel the language and literature of Bengal. On behalf of his countrymen he thanked Mr. Buckland for the excellent paper he had read that afternoon.

Mr. A. Yusuf Ali, LL.M., I.C.S., said the author had referred to the growth of Calcutta historically, to the various *rôles* it had played, and had also touched on the social aspect of the city so far as the English community were concerned; and if he (the speaker) were permitted to make a few remarks in

regard to the social aspect of Calcutta from the Indian point of view, he thought he should be striking a somewhat new line of thought. The first thing that struck a stranger when he first went to Calcutta was the fact that the city was completely the capital of Bengal. He advisedly said the capital of Bengal, because, with all respect to Mr. Buckland, he did not consider it was the capital of India, except in the administrative sense of the word. He did not believe that Indians from Bombay, Upper India, or the Punjab, looked upon Calcutta in the same light as people in England would look upon London, but he was struck with the fact that, to the Bengalis, Calcutta represented practically Bengal in the same way that Paris represented to the Frenchman the whole of France. Confining the city to native society, he believed that what Calcutta said to-day Bengal, but not India, would say to-morrow. He thought that was a very important feature of the social life of Indian Calcutta. There was no other city in India which exactly fulfilled the same function. Bombay was not the capital of Bombay Presidency in the same sense that Calcutta was the capital of Bengal, neither was Allahabad the capital of the United Provinces, nor Lahore and Madras the capitals of their respective provinces. There was, however, one city which he contended was even in a higher sense the capital of a limited area than Calcutta was the capital of Bengal—he alluded to Lucknow. He believed that Lucknow for the last century or more had been even more truly the capital of the province of Oudh, if he might call it a province, than even Calcutta was the capital of Bengal to-day, the reason being that there was scarcely a man of any position in the whole of Oudh, be he landowner, lawyer, or even a considerable peasant, who had not seen Lucknow. All the great Talukdars had houses in Lucknow, and naturally looked forward to the Lucknow season, when they came and paid their respects to the Lieutenant-Governor; and the latter, although Lucknow was not the official capital of the United Provinces, always made a point of staying a few weeks in the city. He did not believe he was divulging any State secrets when he said that there were some Lieutenant-Governors who had even preferred Lucknow to Allahabad; anyhow, the fact remained that Lucknow was a brilliant centre of social life, not only for the English in the United Provinces, but also for the natives in the Province of Oudh. He did not doubt for a moment Calcutta's great importance in the matter of trade, in what it had done for the intellectual development of Bengal, and in the administrative opportunities that any resident of Calcutta enjoyed, but he thought that even in respect of the social advantages that Bengalis enjoyed in living in Calcutta, Lucknow enjoyed a certain amount of superiority. Another point he wished to note was the apparent uniformity of native life in Calcutta. As all who had been to Calcutta knew, there were different streams of life. There were the Marwaris, the Parsees, the Chittagong people, who practically monopolised the river, and the up-country man, who was the chowkidar and labourer. While all those different elements of the population existed, somehow they were so completely merged in the population that, although they preserved their individuality when they were studied in detail,—in the mass, they mingled with the city, and gave the appearance of a uniform Indian life. That was not so in Bombay. Bombay was a city of contrasts. Although the Parsees in Bombay were few in number, one would think that Bombay was peopled by nobody but Parsees, and the colour and brilliancy of the dress of the Parsee ladies in Bombay were absent in Calcutta. Again, the Moguls and the Mohammedans enjoyed in Bombay quite a separate life of their own, but in Bengal, even the Mohammedans seemed to talk Bengali, and to forget the great language which their co-religionists in other parts of India had built up, and of which they were so proud. Of course, he did not in any sense wish to depreciate the merits of the Bengal Mohammedans; he believed they shared to the full all the good qualities, and he hoped not the bad ones, of the Mohammedans in other parts of India, but what he wished to point out was that they were so completely identified with the people of the province that it was true to say the Mohammedans were Bengalis in Bengal, whereas it was not true to say that the Mohammedans were Bombayites in Bombay. These still kept aloof and still formed a camp of their own, or a cave of their own, to use a phrase employed by politicians in this country. The third point he wished to emphasise was the fact that student life played a prominent part in the life of Calcutta. There was the University in Calcutta, which, he believed, claimed to be the first university in India, just as Bombay claimed a similar position as the *Urbs Prima in Indis*. He did not know whether Calcutta people would acknowledge the claim. Having known both Bombay and Calcutta Universities at first hand he knew that the life of the student in Calcutta had a character of its own which was lacking in Bombay. He believed that was also due to the uniformity of which he had spoken. In Calcutta the student, whether he was a Mohammedan or a Bengali in the limited sense of the word, or to whatever caste or grade he belonged, somehow became a real Bengali student. All those who knew the Bengali student would know the type of which he was speaking. He had a society, he had his views, which he was quite willing to air with the importance of a Cabinet Minister, and he always somehow showed that gregarious habit which was wanting in the Bombay student. That, he thought, was a very hopeful sign in the development of the social life. He did not, of course, make any reference to the results of the gregarious habits in certain political troubles of recent times. Those he did not approve of; but allowing for little ebullitions of temper among the students, he looked upon it as a very hopeful sign

that the students should be able to meet together on a social plane, and be able to exchange ideas and to work, as he hoped they would in the future, for the common good. He believed Calcutta was the only Indian city in which there were flourishing institutions like the Native Society for the Advancement of Science. That was quite a revelation to him when he went to Calcutta. As far as he knew Bombay did not possess such an institution, but in Calcutta there were Bengali professors who, in their national costume, came forward and spoke in most excellent English to the students, who also fully understood them, on such abstruse subjects as the properties of argon or the prospects of wireless telegraphy. When he first went to Calcutta he saw a gentleman, dressed in the usual Calcutta costume, taking the chair. At first he thought he was an old-fashioned man, and wondered whether he would speak in Bengali or in English; but to his utter surprise, he spoke a kind of English that was as much superior to the average Indian's English as, for instance, the Urdu of a Maulvi speaking in Lucknow would be superior to the Urdu of the rustic Mohammedan. He was particularly struck with that fact. Afterwards when he went among the students, he found that they looked upon the university as their Alma Mater, and hoped when they had taken their degrees to still work for it. Calcutta had two Bengali professors who had practically a world-wide reputation—Professor Bose and Professor Roy. That student life in Calcutta had a character of its own was very hopeful, if only the students would keep themselves, while they were students at least, to their books and to that abstruse philosophy for which the Bengali intellect showed such subtle capability.

Admiral the Hon. Sir Edmund Fremantle, G.C.B., said that he could not pretend to enlighten the audience on the subject of life in the great Indian dependency in the same manner as the gentlemen who had just spoken, his knowledge of it being principally derived from a sailor's point of view, and it was on that aspect of the question that he desired to speak. He entirely endorsed the remarks made by Mr. Yusuf Ali. He knew Bombay pretty well, because it was the headquarters of the Navy in the East Indies, and it was true that if one visited the city, in certain parts at all events, they would come to the conclusion that it was entirely peopled by Parsees. He had often wondered why Calcutta was called the City of Palaces, because although there were magnificent buildings in the city, the buildings in Bombay very far surpassed them, being in a better position to meet the eye on landing, and consequently to make a much greater effect upon the sightseer than any of the buildings in Calcutta. Mr. Buckland had referred to the movements of Nature in connection with the Hugli. He first went to India when the Prince of Wales, now the King, was visiting the country, and he recollected the magnificent pilotage that was performed on the Hugli. He had a little prejudice against pilots, and as a rule hated to see a pilot on board his ship. The Admiralty view was that the commander should not give up charge to the pilot, and under those circumstances he preferred not to have a pilot there to tell him something which he might think was wrong. But in dealing with a river like the Hugli, whatever the Admiralty instructions were it was necessary to have a pilot. He remembered at the time he had a very good chart, which was only twenty years old, but when he asked for a particular lighthouse he was told that it was several miles inland then, and not at all on the course of the river. On another occasion when he visited Calcutta as Commander-in-Chief in the East Indies, he went up by one channel and came down by another. He would like to mention an incident in connection with the author's remarks about the retaking of Calcutta, "by Clive," after the Black Hole. When he was in India in 1876, Lord Northbrook, the Viceroy, asked him to Barrackpur. He saw on one of the tables there a book, and on opening it he found it was presented by Lord Napier of Ettrick to the Viceroy on condition that it should always remain on the table at Barrackpur, in a certain room. When he had the honour of visiting Lord Curzon, in 1900, he asked for the book and found it was there, but not on the table; it had been found necessary to put it a little under cover. As a nautical man he found that book exceedingly interesting, and on a certain Sunday afternoon he read it pretty well through. It was a most interesting book, written by the doctor of Admiral Watson's ship, and gave a full account of the operations in the year 1757 at the re-taking of Calcutta. He was struck with the fact that in Haydn's "Dictionary of Dates" and other works of reference it was said that Clive re-took Calcutta in 1757. He begged leave to say that it was the navy under Admiral Watson which re-took Calcutta, assisted by a very distinguished rising officer of the name of Clive, with 500 men. That was really the fact. There was a tremendous engagement at Fulta on the way up; the ships silenced part of the forts, and then the military and sailors were landed—more sailors than soldiers—with a view to taking them. The fort had been bombarded, and it was intended to make the assault next morning. By some mistake, however, a bluejacket got rather intoxicated, and assaulted the fort by himself. He was followed by a great many other people, and the place was taken. Afterwards, Admiral Watson told him how disgraceful a thing it was to get drunk, and the sailor replied that he would never take a fort again! That was perfectly true. There was also a very heavy engagement in which Admiral Watson's flagship lost 42 men at Chandanagore, then and still a French settlement. He wanted to emphasise the remarks he had been making because the re-taking of Calcutta was really due to his own service. He thought it was an extremely creditable performance

on the part of Admiral Watson, who went up from Madras against the north-east monsoon, who then undertook to go up a river that was so extremely difficult to navigate, and who went up not only to Calcutta past the Fulta batteries, but on to Chandanagore, then strongly fortified.

SIR GEORGE BIRDWOOD, K.C.I.E., said he was not entitled, because he happened to know Bombay, to criticise a paper on Bengal more than any others of the audience. Calcutta was about the distance from Bombay that London was from St. Petersburg, and we had been learning during the past six months how little we islanders here know of the great Neo-Grecian city by the Neva. But no one could appreciate better than he the labour Mr. Buckland had so well bestowed on his paper, or the skill with which he had so clearly and effectively arranged, within the limited time and space allowed him, the immense and perplexing body of facts compressed into it. It was in every way an excellent paper for which they were all most grateful to Mr. Buckland. He could have wished that Mr. Buckland had dealt more with the difficulties with which the earlier makers of Calcutta, as those also of Madras and Bombay, were beset, arising out of the ever-nervous policy of the authorities at Home. The Presidency of Bombay was never to be extended across the Tannah Creek; nor the Presidency of Bengal to overleap the Mahratta Ditch. In short everything we had done in a great way in those our heroical days in India had been done by our officials on the spot, and on their own responsibility, and often in deliberate defiance of the wobbling authorities at Home. This had continued in many an exemplary instance even to our own day. Sir Edmund Fremantle had contrasted the magnificent effect of the architectural integrity and indivisibility of the many languaged city of Bombay, rising like a second Venice out of the sea, with the casual, broken, and sectional architectural aspect of Calcutta. But when Calcutta won the legend of "The City of Palaces," Bombay was the agglomeration of villages of tiled shanties, and *kadjan* huts he (Sir George Birdwood) knew it in 1837-9; and it was by the fervent genius of Sir Bartle Frere, and the administrative ability and energetic devotion of Arthur Crawford, exercised in sustained contempt of every form of obstruction both in India and at Home, that it was within five years transformed, one may well say transfigured into that imperial city, of true architectural unity—in picturesque diversity—with itself, now known as "Bombay the Beautiful," and "The Queen of the East"; its proud citizens of to-day deriving its name, to the slight of all historical truth, from *moh* "attraction" and *mayi* "abounding"—that is "The City of Enchantments;" an unconscious tribute, of which so many are to be found in the folk parlances of modern India, to the great peace and prosperity of the country, and the joy of its people therein, under the beneficent over-rule of England. He advisedly dwelt on this point. Home-staying English people were sometimes depressed by the way in which they heard the imperial interests of their country discussed among themselves. But those of us who know our kinsman abroad in the wide scattered States, Dominions, Commonwealths, Confederations, and Dependencies of our race, and who know the agricultural and working classes at home, by whom our colonies "beyond seas" had been founded, know that we are the same Englishmen and Scotsmen, and Irishmen to-day, that we have been for the past 300 years, back to the great uprising of the English middle classes in the days of Queen Elizabeth; and that wherever we may be, whatever is considered by us necessary to the interests, and pride and glory of the race, will be dared and done by us, and right thoroughly to its pre-determined end; and, if necessary, in defiance of all *caveats* from Home, whether London or Washington. Sir Edmund Fremantle had referred to the way in which the recapture of Calcutta, by Admiral Watson in 1757, was ignored in Joseph Haydn's "Dictionary of Dates." The glory of it is all given to Clive. But the gallant admiral would find that full justice was done to Admiral Watson in more voluminous works of reference, and in the systematic histories of India, such as the "Encyclopædia Britannica," and Sir William Hunter's "Gazetteer of India," and his other incomparable writings. He would, in conclusion repeat, that nothing could exceed the warmth of the gratification Mr. Buckland's paper had given him, and of the thanks he desired to express to him.

MR. R. B. CHAPMAN, C.S.I., said he should not be surprised if he was the oldest qui-hye present, because it was close upon fifty-six years ago since he landed in Calcutta. He spent many happy years of his official life in Calcutta, and found no difficulty in living in the city, even fifty-six years ago, although the author gave it rather a bad character for health then. At that time, there were no drains in the city and no water supply. He remembered that one of the great amusements of the young people—he did not say he ever took part in it himself—was hunting the big bandicoot rats about the open drains; and when their friends came down to Calcutta to visit them they used very ostentatiously to hold their noses as they went about the place. That, on many occasions, greatly offended him, and he told them that it was merely their noses that were badly trained. However, even then, Calcutta was bearable and pleasant, and as a social place he always found it most delightful. He did not confine his friends only to Europeans; he was always on very good terms with the natives, and so were the merchants. In the early days, the banians of the mercantile firms were the trusted friends of the Europeans, and he remembered hearing of many a kindly act performed by native gentlemen when perhaps their employers had fallen on evil times. Calcutta people never quite

accepted the mofussil verdict about Calcutta, nor even the Bombay verdict. He used to observe that when Bombay people came and pitched their tents in Calcutta they thought the city was a splendid place, and that when Calcutta people went to Bombay they in their turn thought that Bombay was the most delightful place on the face of the earth. Each city had its own merits. He was glad to hear Mr. Buckland emphasise the statement that Calcutta owed its importance almost entirely to commerce, and he had been greatly interested in the discriminating remarks made in regard to the fact that in native opinion Calcutta was only the capital of Bengal and not of India.

The CHAIRMAN, in proposing a very hearty vote of thanks to Mr. Buckland for his excellent paper and for the beautiful views he had shown, said he was sure that the cells of their memories had been opened, and that they had all looked with great pleasure on the places in which they had spent so many happy hours. He quite agreed with Mr. Buckland that life in Calcutta was extremely enjoyable. He had spent fifteen or sixteen years there himself, and if he had his life to live over again he should be only too delighted to go through what he did in that city.

NINTH ORDINARY MEETING.

Wednesday, January 31st, 1906; FABIAN WARE in the chair.

The following candidates were proposed for election as members of the Society:—

Arsiwalla, Mehervanji Navrozji, 4, Pitha-street, Fort, Bombay, India.
Bomanji, Eruchshah Pestonji, Chowpaty Art Studio, near Wilson College, Bombay, India.
Canziani, Enrico, 3, Palace-green, Kensington-palace-gardens, W.
Evans, M. Llewellyn, Stony Down, Sidcup.
Ford-Moore, Arthur Pilcher, A.M.I.C.E., M.I.M.E., 28, Warwick-road, Ealing, W.
Goff, Sir William G. D., Bart., D.L., Glenville, Waterford, Ireland.
Hodgetts, Charles Alfred, M.D., L.R.C.P., Provincial Board of Health, Toronto, Ontario, Canada.
Mookerjee, S. C., Imperial Druggists Hall, Umballa, India.
Polson, Franklin Bates, Polson Iron Works, Limited, Toronto, Canada.
Pullar, Rufus D., F.C.S., Brahan, Perth, N.B.
Raghavyya, B. C., B.A., High Court Vakil, Chittur, N. Arcot, India.
Stapledon, William C., 2, Marine-park, West Kirby, Cheshire.
Vicarey, R. W., Pen-y-cwm, Blackhill, Clun, R.S.O., Salop.
Walsh, Thomas Crosbie, Casilla 95, Antofagasta, Chili, South America.
Webb, Bernard Hugh, 2, South-square, Gray's-inn, W.C.
Wells, Miss Theodosia Mary, Grosvenor-crescent Club, Hyde-park Corner, W.
Whitaker, Mrs. William, 26, Curzon-street, W.
Witherspoon, Henry R., 43, Eyot-gardens, Hammersmith, W.

The following candidates were balloted for and duly elected members of the Society:—

Banaji, Khoshru Nowrosji, The Commercial Studio, Raopura, Baroda, Bombay, India.
Baylay, Major Frederick, R.E., Brompton Barracks, Chatham.
Bennett, William, J.P., Bank-house, Grimsby.
Chatley, Herbert, B.Sc., Burlington-house, Osborne-road, Southsea.
Claret, William Edward, Tottenham-house, Moulton, Northamptonshire.
Clarke, Archer, 29, Winchester-house, St. James's, S.W.
Craig, Charles William, Southern Punjab Railway, Bhatinda, Punjab, India.
Curtis, Walter Septimus, M.A., 4, Norfolk-crescent, Hyde-park, W.
Davis, George Herbert, 5, Tressillian-crescent, St. John's, S.E.
Duncan, Harold Malcolm, Fairlawn, Weybridge, Surrey.
Dutt, Girindra Nath, B.A., Hutwa Raj, Hutwa, District Chapra, Bengal, India.
Fortescue, Hon. John William, The Library, Windsor Castle, and 59A, Brook-street, W.
Godsal, Capt. William C., Wootton Bassett, Wilts.
Harris, George, 36, Lime-street, E.C.
Hermesson, John Louis, A.M.I.E.E., Santa Lucrecia, Estado de Vera Cruz, Mexico.
Holland, Alfred Robert, Leesons, Chislehurst, Kent.
Jacob, Edwin, 119, Victoria-street, S.W.
James, Alexander Dean, 59, Langdale-road, Thornton-heath.
Kapadia, Framjee Dorabjee, Jumulpoor-gate Calico-mill, Ahmedabad, India.
Littledale, Colonel H. C., care of Messrs. Coutts and Co., 440, Strand, W.C.
Mac Arthur, John Stewart, 74, York-street, Glasgow.
Marris, H. Clifton, 32, Kourlandskaia-street, St. Petersburg, Russia.
Price, R. Arnold, 3, Queen Victoria-street, E.C.
Richardson, Henry Adair, M.A., 7, Canfield-gardens, Hampstead, N.W.
Rothwell, Commander William Henry, R.N.R., care of Messrs. Mackinnon, Mackenzie and Co., Bombay, India.
Sharman, Alexander William, 13, Broderick-road, Upper Tooting, S.W.
Smith, Charles Edward, San Martin 354, Rosario, Argentine Republic.

Tillotson, J. L., Heathfield, Bebrington, Cheshire.
Topham, James Jerom, Laurick, Ridge-road, Durban, South Africa.
Turner, Rev. George Lyon, M.A., Crescent-lodge, St. John's, Brockley, S.E.
Walker, J. Ewart, 2, Pump-court, Temple, E.C., and Mancunium, Anerley, S.E.
Ward, Arthur Egerton Neville, 65, London-wall, E.C.

The CHAIRMAN, in introducing the reader of the paper, said that probably nothing struck one who had been out of the country for some time, on returning, than the enormous progress that had been made in practical experiments to solve the problems which had arisen in connection with the development of industrialism. Some five or six years ago, most of the efforts were directed to theorising on all the questions raised. Practical experiments were now, however, being carried out on all hands, the great importance of which could not be over-estimated. But the mere theoriser was still with them, and on all sides protests could be heard from the public against his existence. There were also a number of people who always seemed to be loudly knocking at the door which leads to the straight path to the top of the hill of progress; but there were others who did not mind how they approached the hill so long as they could make a way to the top. That was the attitude of the practical experimenter; and none of the experiments were more interesting than that which was being carried out by the First Garden City. The name was not, perhaps, altogether a happy one; it sometimes, he was afraid, raised a smile, and recalled one's earliest lessons in Bible history, but the work it was doing was of the most practical nature. There was nobody who could give a better account of the practical results which had been achieved than Mr. Adams, who had been the secretary of the First Garden City since its commencement, and who had been very largely responsible for the administrative control of the work carried on.

The paper read was—

THE GARDEN CITY AND THE CHEAP COTTAGE.

By THOMAS ADAMS,
Secretary, "First Garden City, Limited" and the "Garden City Association."

PART I.

It is one of the admirable qualities of the old established and distinguished society, which I have the honour to address this evening, that it has always played a prominent part in the intelligent anticipation of events, and that it has ever been one of its main objects to encourage experiment, to look kindly on new ideas, and to welcome every effort to secure the application of science and art to practical purposes. It has only been by the persistent and well-directed efforts of such societies that the full value of careful and painstaking experiment in all branches of the sciences has come to take its proper place; and now-a-days when the questions of the social and civic betterment of the people are regarded as more than merely political questions, discussed and settled at the hustings without proper investigation, it is necessary for us, in the interests of real progress, to apply, not only scientific investigation of existing facts and statistics, not only careful analysis of men's experiences, but also the true test of the careful practical experiment based on the best knowledge available on the subject.

In other words experiment is as important in regard to schemes which aim at the social amelioration of the people, as it is in the domain of the more correct of the sciences, and as such questions as the reform of our poor laws, land laws, and, other national institutions, are now being seriously discussed, it behoves those who desire to see permanent good result from any reform to insist on careful isolated experiment before any drastic legislative proposal is pressed upon the country.

It is as an experiment, and one which within certain limits, has already succeeded that I wish to speak of the Garden City movement to-night. However successful that movement might continue to be if left to private enterprise, there can be no doubt that it could be largely assisted, and its value to the nation could be increased tenfold by proper legislation. It is therefore hoped that the new Government which has announced its intention to make a specialty of social reform will give proper heed to the lessons of this great experiment, and the causes of the evils it presumes to solve.

After an inquiry into the *raison d'être* of the movement, I wish to present the subject to you in the following order:—

1. The scheme suggested by Mr. Ebenezer Howard.
2. The practical steps taken to carry the scheme into effect; a description of the Garden City at Letchworth, and the measure of success which has attended the operations of the Garden City Company up to the present time.
3. The Cheap Cottages Exhibition—what it set out to prove and whether it succeeded.

4. Bournville, Port Sunlight, and other examples of industrial re-distribution.

Surely this provides us with a sufficiently comprehensive programme for one evening, and with such a wide field to cover I must necessarily ask you to take some of my contentions for granted, though, I presume, there will be an opportunity at the end for me to deal with any doubtful points which may arise in your minds during the reading of the paper.

The first question to be answered is—What is the *raison d'être* of the Garden City movement? Why and wherefore was it called into being? Is its sole or principal object that of insisting on every house, or cottage, having a garden? Or is it merely another suggestion for the creation of a fanciful community such as has been pictured in the imaginative prose of Bacon, More, or Bellamy? Or is it something more ambitious and serious; something less tinctured with impractical sentimentalism?

In sitting down to consider how briefly to set out the social evils which have called the Garden City movement into being, one finds oneself perplexed with the great mass of heterogeneous material which exists in the form of statistical treatises on death-rates, scientific investigations into the questions of hereditity and environment, and reports of the Royal Commissions and Departmental Committees which make serious recommendations that never come to anything. Amidst all this fragmentary evidence one cannot meet with a really good standard work setting forth the principal social evils of our times and showing what efforts have been made to overcome them. Here, surely, is a splendid opportunity for such a society as this to take up the task of producing a really authoritative sociological encyclopædia. But that by the way.

The most striking phenomenon which presents itself to the sociological student to-day is that the health and character of all civilised races are suffering great injury as a result of the unequal distribution of the population between town and country. In Great Britain, which is one of the oldest and most densely populated nations, this inequality is probably greater than in any other part of the world. With us, the evils of overcrowding in towns and depopulation in rural districts have reached an acute stage, and every serious-minded citizen must desire to see some effort made to deal with both problems. According to the census returns for England and Wales the urban population is 77 per cent. of the whole, whereas only fifty years ago it was only just over 50 per cent. For every person who lived in a town in 1851, about three are so situated at the present time.

It is said, in some respects truly, that this is the result of economic and other laws, over which we have no control. Why should we worry about a process that is the inevitable result of the industrial revolution; that merely means that the poor labourer has left, or is leaving, his insanitary cottage in the rural village for the probably more sanitary even though much over-crowded tenement in the town? It seems to be his choice for a variety of reasons, and it almost seems vain on our part to strive against a movement which has become so general and the causes of which are so deeply rooted.

But is it really the case that the sunless, sanitary, much less the insanitary, house in the crowded air-polluted city is as good as even the insanitary cottage in the village? Or to institute the comparison within an urban area, are the model tenement dwellings of the County Council more healthy than the two-storied insanitary cottages in our mean streets, crowding, as they do, many more people on the acre? If we examine the statistics of the death-rate they seem to prove conclusively that the system of warehousing people in tenement dwellings, while it may be in some cases a necessary evil, is entirely opposed to common sense, and deleterious to the health of the people.

According to the report of the International Departmental Committee on Physical Deterioration, the general death-rate of Glasgow tenements is nearly twice that of the whole city, and the death-rate from pulmonary tuberculosis is 2·4 per thousand in one-roomed tenements, 1·8 in two-roomed tenements, aud 1·7 in all other houses. In Finsbury again, where the population of one-roomed tenements is 14,516, the death-rate per thousand in 1903 was 38·9, yet the rate among occupants of four or more rooms was only 5·6, and for the whole borough 19·6. The most startling and unfortunate feature of this story of the death-rates is that the high percentage is principally due to the high death-rate among children, illustrating the extraordinary waste of material during the early years of life.

The above report states that as the proportion of people living in overcrowded tenements increases, so does the infant death-rate; going up from 180 to 210 and 223 per thousand. "Facts like these," says the report, "show

where the root of the mischief lies, and surely the time is ripe for dealing drastically with a class that, whether by wilfulness or necessity, is powerless to extricate itself from conditions that constitute a grave menace to the community; by virtue of that taint that is communicated to those who suffer under them and of the depressing effect that the condition of these people exercise on the class immediately above."

I am of opinion that the taint not only affects those below, but that in addition to the depressing effect on those immediately above, this degraded class is the constant source of disease and of moral injury to all classes with which they come in contact. Nor do I believe that you can solve any problem of this character by merely trying to cure those who have become demoralised, by housing them at the expense of the rates, or by creating employment for those who have become unemployable. There is room for the activities of many in carrying out these palliative measures, but the present system of haphazard charity is as foolish in the interest of the national welfare as it is degrading to the national character. The problem of growing pauperism is by no means the least harmful of the social evils of our times.

Any serious attempt to deal with these great questions of overcrowding and depopulation must, however, be in the nature of prevention rather than cure. You must first diagnose the causes of the disease and thereafter proceed, as far as you can and with proper prudence and foresight, to remove them.

For the above reasons and numerous others we must conclude that under present conditions, the urbanisation of the people is destructive to the physique, the mental strength, and the moral character of the people. I wish to emphasise the words, under present conditions, for surely the mere urbanisation of the population is not in itself an unhealthy thing. The fact that the people prefer to take up industrial instead of agricultural pursuits does not mean that they must necessarily live unhealthy lives, and is not *à priori* a cause of overcrowding. Town life can be made, under modern conditions of sanitation and good water supply, as healthy as country life from the merely physical point of view; it is oftentimes, if not nearly always, more healthy from the intellectual standpoint. The fact that people huddle together in slums is not a result of industrial concentration, it is because that concentration has not been properly controlled and directed.

While we may therefore admit that the present displacement of agriculture by manufacture, as our principal industry, is the result of fixed and natural laws, we must not assume that overcrowded and unhealthy towns are a necessary consequence of their operation. If, as you will probably agree is the case, the nation must continue to depend on its manufacfacturing industries for the growth of its wealth and continued prosperity, the obvious and sensible thing is not entirely to "back the tide" from these industries to agriculture, even if that were possible,—not to destroy our towns, but to re-create them. We want more men attached to the soil, and English agriculture must be improved, but that object will never be attained by attempting to re-convert the town artisan into an agricultural labourer. We must spread our town industries over wider areas, and bring manufacture and agriculture into closer contact. We must utilise modern transport facilities, and take hold of the tendency of manufacturers to move out to country districts, to blend together the town and country, securing for each the advantage of both.

It is because great cities like London have grown up in a haphazard fashion that the evils of overcrowding, congestion, foul air, and bad sanitation have arisen, and not merely because more people find it necessary to live on one square mile.

Let us look at the question more closely, for a moment, from the economic point of view. As a result of this aggregation, site values have increased so enormously that it is impossible to provide housing accommodation in the crowded central districts except in the tenement dwellings to which I have referred; and even then at great loss to the rates. It is also enormously costly to widen existing main thorougfares sufficiently to deal with the necessary traffic, irrespective of the question of future growth.

Concurrently with this problem in the towns we have the problem of the depletion of country villages causing a deficiency of business and social conveniences.

According to the statistical information provided by the Royal Commission on locomotion and transport in London, the population per acre is divided as follows:—

London central area	....	148 persons per acre.
London County ,,	....	54 ,, ,,
Districts adjacent ,,	....	16·6 ,, ,,
Extra London ,,	....	2·5 ,, ,,

Here we have, on this huge area, a population which only averages about 25 persons per acre, and yet nearly one-seventh of the whole are living in over-crowded conditions. Outside extra London as we recede further into the country the land becomes still more thinly populated. The other extreme is found in counties like Westmorland with its one person to every eight acres.

In addition to the unequal distribution of the people there is that vast inequality in land values which provides an enormous return per acre to the urban landlord; and on the other hand does not enable the rural landlord to obtain an economic return on the capital he has invested. An acre of land may be worth £100,000 in central districts of London occupied by workmen's dwellings, while from 12 to 15 miles away in Essex you can purchase as much as you require at £20 per acre, and yet you will probably earn 5 per cent. interest on the town investment against a probable 2 per cent. on your rural investment. With modern transport facilities as they are, this should not be, but unfortunately only the minimum advantage of these facilities can be obtained. In the first place, any improvement in our railway or tramway systems, often carried out at the public expense, presses up the rent of land in the district served by the improvement, and the chief benefit is thus given to the landlord. Secondly, the congested areas in the central districts of London not only prevent the improvement of the means of locomotion within these areas, but prejudically affect the travelling facilities within a radius of at least fifteen miles from the centre. The frequency and rapidity of the locomotive services are governed within that small circle where the innumerable arteries of rail and road connect up with the throbbing heart of the metropolis. The Commission on Locomotion, already referred to, reports:—

"The chief difficulty in the way of improving the means of locomotion in London is the narrowness of the streets, and the fact that they were not originally laid out on any general plan. If the streets were of sufficient width and had been laid out on a regular plan the congestion of the vehicular traffic would practically disappear."

Exactly the same argument applies to railroad traffic.

In an able paper read to you by Mr. W. L. Magden in 1902, the question of transport and business congestion was specially dealt with. Mr. Magden then quoted Sir J. Wolfe Barry's estimate of the public loss due to the congestion of traffic at four points in London as equivalent to a monetary loss of £2,154,000 a year. On that occasion, however, Mr. Magden questioned the practicability of the Garden City method of distribution, which involved the planning of new areas to accommodate migrating industries, and advocated that these industries should rather move to existing country towns. But as we see from the above quotation from the Traffic Commission, one of the chief causes of the congestion deplored by Mr. Magden is the very want of planning which he did not regard as important.

One aspect of the question on which special stress is laid by Mr. Magden is the necessity of the labourer living within a convenient distance of his work. Mr. H. G. Wells, in that prophetic work, "Anticipations," speaks of the diffusion of great cities, and looks forward to the day, probably not far distant, when greater London will contain its 20,000,000 souls. He pictures to us how this growth can be directed so as to provide healthy conditions for the whole. He puts the maximum daily journey of the worker as two hours—one in the morning and one in the evening—and on this basis he calculates with mathematical precision how the size and type of the town is governed by transport facilities. First we have the pedestrian town of earlier times with a radius of four miles; next the city of the cab or 'bus, which extends to six miles from the centre; and to-day the suburban train, tube, and tram town, which spreads out ten to fifteen miles in all directions. To-morrow, says Mr. Wells, 30 miles will be a moderate estimate of the hour limit between house and warehouse, and the London worker will be able to live that distance from his work, and there will be an enormous area of 2,800 square miles available for the population of London. I do not agree with this method of growth because of this suggested continued separation of the worker from his work. Adam Smith taught us long ago that human merchandise is the most costly to transport, and by pursuing the present system of concentrating our factories in the centre and causing our work-people to live in the far-off suburb, we are going in the teeth of economic law, and throwing away vast resources of wealth. We must not only reduce the density of population of our great cities by diffusing it over wider areas, we must, at the same time, endeavour to diffuse the industries in which the greater part of it is employed.

The Royal Commission on the Housing of the Working Classes laid down in their report that "the majority of the poor labouring population were under compulsion to live near their work," and that their earnings were at a rate that "left no margin for the extra cost of travelling expenses."

As to the feasibility and desirability from other points of view of securing the redistribution of manufacturing industries, I will only say that it is everywhere apparent to the ordinary observer. As one firm says on its prospectus with regard to London :—

"Every day that passes sees some one or other of the larger London works closed. In some instances they are closed never to re-open, and in others, they are removed to a provincial town or some country district. The reasons for this are many, but suffice it to say here that London is fast becoming an impossible centre for works of any dimensions."

Both Mr. Cadbury, of Bournville, and Mr. Lever, of Port Sunlight, admit the enormous advantages they have obtained by moving into the country, and, apart from other considerations, Mr. Lever has told me that he estimates that each of his men is worth 4s. per week more to him than if he lived in a crowded city.

Not less than 1,000,000 of people in London alone are engaged in or dependent upon manufacturing industries that could be more profitably carried on in the country. These include such industries as the following:—Printing, bookbinding, bootmaking, engineering, clothing, cabinetmaking, also stationery, mineral waters and confectionery. Notwithstanding the unsatisfactory condition in which the people employed in these industries live and work, the best of them have to pay away from one-third to one-fifth of their income in rents and rates. In this connection let me glance for a moment at the housing schemes of London County Council.

In all the housing experiments which the London County Council has made within the crowded areas of central London a considerable loss has been shown, and this has had to be borne by the rates. In their Tooting and Tottenham schemes, however, it will be possible for them to show a profit.

I give the following figures from an authoritative source which shows us how the two kinds of experiment work out.

On the Bourne estate purchased by the London County Council to carry out the Holborn to Strand improvement the actual cost for three-roomed tenements was as follows :—

Land	£454	4	0
Building	307	8	6
	£761	12	6

On the Tooting estate the cost of three-roomed cottages was—

Land	£ 28	15	0
Building, &c.......	234	15	0
	£263	10	0

In the first scheme, rents of 9s. and 11s. weekly had to be charged for the three rooms, even after writing down about one-fourth of the actual cost of the land. The actual loss to the County Council works out at £60 per head of the persons re-housed. At Tooting the rents of three-roomed cottages are from 7s. to 7s. 6d. per week.

Owing to the high rates payable in suburban boroughs of London, the difference between the above rents is not so favourable as it should be. In Walthamstow, for instance, the greater part of the dwellings are assessed at £16, and the low rateable value is responsible for very high rates. Unfortunately, when we add the cost of travelling to the rent of the suburban cottage, we shall find that the tenant is actually paying away as large a part of his income as the tenant in the central area. So long as you keep the factories in the centre it matters little from the economic point of view whether the worker pays 9s. for three rooms off the Strand, or 7s. for the same accommodation at Tooting, as in the latter case he would require to pay at least 2s. per week in fares. We may therefore estimate that the London manufacturer has to pay a wage which will allow his *employés* to meet a rental of at least 9s. per week.

On his factory the latter has also to pay a second rent in the form of rates, which will represent at least 50 per cent. of the rental value of his property, and the insurance premiums he pays are based not on the risk involved within his own premises, but probably because of near proximity to another factory dealing in inflammable materials. We shall return to this question of rent and rates presently when we are considering the question in relation to Garden City.

So far, I think, we have come to the following conclusions :—

(1.) The population of the country is very unevenly distributed over the land, and the greater part live in crowded areas causing great injury to health, while the country districts suffer from want of population.

(2.) This overcrowding is in spite of great improvement in transport facilities, and of the high price of land in the towns; while depopulation of the rural districts continues, notwithstanding the comparatively low price of land and the healthy conditions of life.

(3.) Overcrowding is not due to the scarcity of land even within convenient distances of business centres, but to the unequal distribution of the population upon it.

(4.) You cannot solve the problem by taking the people back to agricultural pursuits, but only by the redistribution of manufacturing industries, and thereby the wider distribution of the population.

(5.) It is not a satisfactory solution of the problem to house the worker in the suburb and separate him by long distances from his work, even if you provide cheap and fast transit.

Having, as I think, proved these points, I will now take up my principal subject of arguments, viz., what are the remedial measures to be employed to cure these evils? I hold that

(1.) The cheapness of land in country districts accompanied with the improved methods of transit and the tendency of manufacturers to move out of crowded centres provides a great opportunity for creating new towns, built according to plan, and in which every hygienic safeguard will be employed.

(2.) The permanent association of urban and rural life secured by industrial decentralisation, the fact that it brings social attractions and a market to the door of the farmer and agricultural labourer, will help to increase the amount of labour employed upon the land, and restore some prosperity to agriculture.

(3.) The combination of manufacture and agriculture thus secured will help to solve the twin problems of overcrowding in the towns and depopulation in the rural districts, on a sound economic basis.

The project which I wish to present to you as a means of attaining these objects, is what is familiarly known as the Garden City scheme.

Part II.

The scheme advocated by the Garden City Association is the outcome of a book which was published in 1898, entitled "To-morrow," by Mr. Ebenezer Howard. The principles underlying Mr. Howard's scheme may be shortly stated as follows:—

1. The purchase of a large agricultural estate with the object of establishing a residential and industrial town as an experiment in housing and important social and industrial reforms.
2. The retention by the community of this town of the anticipated increase in the value of the estate caused by its conversion from country into town.
3. The estate selected to be carefully planned under the best expert advice, so that as the town grows, its factories and workshops, the houses of the people, the parks and open spaces, schools, churches, and other public buildings may be placed in the most convenient positions.
4. The provision of a belt of agricultural land round the town, under such restricted covenants as may secure to the inhabitants the enjoyment for all time of the combined advantages of town and country life, while the agricultural tenants may have a market for their produce brought to their doors and the advantages of security of tenure.
5. The provision for manufacturers, co-operative societies, and private individuals of sites for works, stores, and houses, under leases, which, while giving the fullest security to tenants for all improvements made by them, would secure to the community the ultimate increased value of the land, such increased value to be expended for the benefit of the town.
6. The retention of a large amount of open space for recreative purposes, and for the allowance of land for a fair-sized garden to each house, as far as practicable.

A society, called the Garden City Association, was formed in 1899 to advocate the essential principles of Mr. Howard's book, with a view to their realisation.

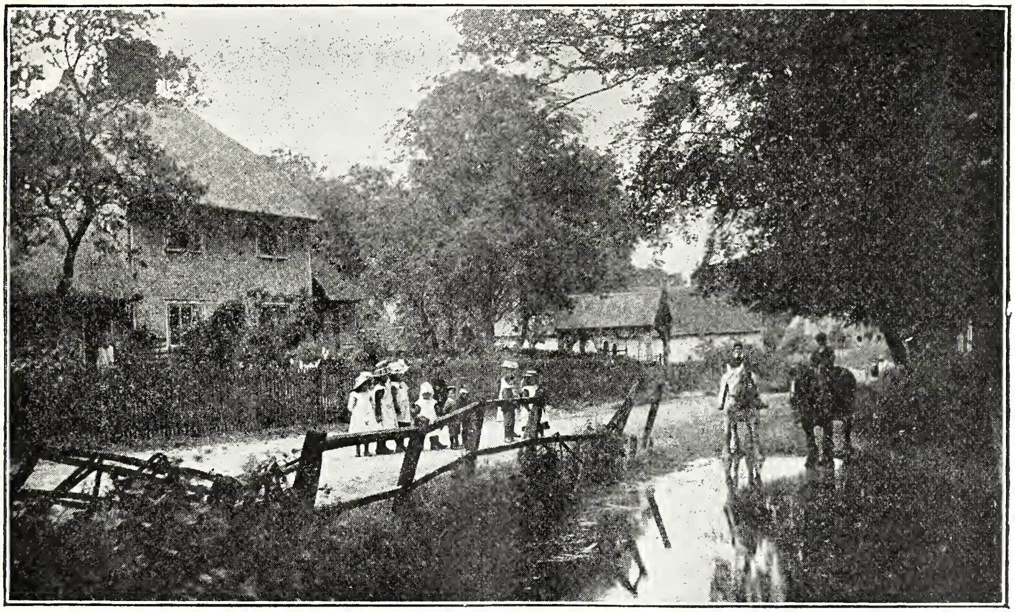
First Practical Steps.

As a result of this propaganda the Garden City Pioneer Company was formed in 1902 with a capital of £20,000. Its object was to investigate estates and interview manufacturers. A year later, the choice of the company fell on the Letchworth estate near Hitchin, and a further company, called "First Garden City, Limited," was formed with a capital of £300,000 to purchase and develop the property. Of that sum about £132,000 is subscribed to date, which is in itself satisfactory

testimony to the excellence of the project and the energy of the promoters.

The estate purchased by the Company comprises an area of 3,800 acres, lying in the extreme north of Hertfordshire, one and a-half miles from Hitchin Junction, on the main line of the Great Northern Railway.

It was acquired at the average price of about £40 per acre, including buildings and timber, and is admirably adapted for the purpose of residential and industrial development. The object of the company will be to develop on this estate a model town, as far as possible, on the lines suggested by Mr. Ebenezer Howard.



Norton Village.

When acquired by the company, the population on the estate, including the two villages of Willian and Norton, was about 450. There was also a population of about 20,000 in towns and hamlets within three miles, thus ensuring a local supply of labour ; nearly the whole of the property is in the Hitchin Rural District, and comprises the parishes of Letchworth and Norton, and parts of the parishes of Willian and Radwell. The population is now about 1,500, and will very shortly number 2,000. As nearly the whole of the first year was absorbed in contouring, preparing the plan of development, &c., it is only fair to estimate the period during which active building operations have been proceeding as about 18 months.

The estate is traversed by important highways, and for a distance of two and a-half miles by the Great Northern Railway main line from London to Cambridge, and is within one and a-half miles of the Great Northern main line from London to the north, and of the Midland line from Bedford to Hitchin.

The Great Northern Railway Company has constructed a new temporary station in the centre of the estate. There are also fifty-two trains per day to and from London and Hitchin, the fastest taking only 39 minutes in the journey, as well as a good service from Letchworth Station, in the middle of the estate. Between 30,000 and 40,000 people passed through the station last summer. Goods sidings have been provided capable of dealing with a large amount of traffic, and it will be possible, under the scheme of development to provide private sidings for about 120 acres of factory sites.

The sidings and factories will be grouped together, and screened from the residential quarter of the town by a hill, and a belt of trees. In view of modern developments in gas and electrical power, steam is not likely to be largely used for manufacturing purposes, and smoke will be much less prevalent in Garden City than in older towns. At present an electrical installation has not been provided, but gas works have been erected and gas is being supplied at the low cost of 3s. per thousand cubic feet for domestic purposes and 2s.

per thousand cubic feet for power. The result of this liberal policy in supplying gas at cheap rates is that the use of gas engines and stoves is encouraged and an abatement of the smoke nuisance is secured without any arbitrary restrictions.

The estate is excellently situated for urban development and over 1,000 acres in the centre can be drained to one point. Sewers have already been laid along the roads on which development is taking place, and up-to-date methods of sewage disposal are being employed under the best expert advice. Water of excellent quality is obtained from a borehole 200 feet deep, round which the Company will preserve a considerable area of unbuilt-on land. The present supply is considered sufficient for 6,000 inhabitants.

The area occupied by the town is about 1,300 acres, including 100 acres of parks and open spaces, and the agricultural belt comprises about 2,500 acres. Provision is made in the town area for a population of about 30,000 persons, or about 35,000 inclusive of the villages and the population engaged in agricultural pursuits. The density of the population will average about 23 per acre on the town area and 9 per acre over the whole estate. The agricultural estate will comprise about 2,500 acres, or nearly two-thirds of the whole estate, and its preservation as a permanent feature of the scheme will greatly enhance the value of the town as a place of residence.

The development of the large area to be thus devoted to agriculture will form not the least important part of the scheme. It is well known that where small holdings can be established in touch with a proper system of agricultural organisation and education, and under a system of tenure which gives the tenant security in the development of his holding, agricultural depression and rural depopulation scarcely, if at all, exist. The Garden City Company will set aside a large part of its estate for small holdings, and will secure the provision of the necessary co-operative and other facilities for making these successful. In this way it will provide an object-lesson of great value to the country. Several small holders have already taken land, and a Small Holding and Allotment Society and an Industrial Bank have been formed on the estate. A society possessing capital is about to lease an area of between 100 and 200 acres on which to develop immediately a model small holdings village.

STATION-ROAD, SHOWING BELT OF TREES SCREENING FACTORY SITES.

The intention of the Company is to set aside about 200 acres of land for public parks and open spaces, including 70 acres of Norton Common and a golf course which has been laid out in Letchworth Park.

Sites for from 400 to 500 houses and cottages have been let, about 300 new houses are erected or in course of erection, and about 200 of these are already occupied. Sites have been let to seven manufacturers, and several others have taken sites for the erection of works. Three firms have started operations on the estate. These include the Heatly-Gresham Engineering Company, which will employ about 150 men when finally established.

"It is further to be borne in mind that the rents paid by tenants are not absolutely outgoings as rents ordinarily are, but a considerable proportion will be available for purposes which are paid for in existing towns out of the rates. The construction of roads, sewers, and the provision of open spaces and all costs of development, the burden of which usually falls upon the local authority, and is, therefore, charged to the tenants, either in the form of a capital charge or as rates, will be met in Garden City out of ground-rents. There is therefore no comparison between the ground-rent payable in Garden City and that payable in other districts in which the freehold price only covers the actual cost of the land. Moreover, the actual cost of public services will, it is obvious, be less in a city planned from the beginning, and the

NORTON WAY—COTTAGES AT ABOUT 8S. 6D. WEEKLY; Five rooms, hall, bath-room, &c.

site of which has been bought at agricultural value, than in ordinary towns, where public services are carried out only after land is at a high price and numerous vested interests have grown up. The supply of water, gas, and other services will be carried out by the Garden City Company in the public interest, and any profits from these supplies will be dealt with similarly to the other profits of the Company. Putting these two facts together, it is evident that rates should remain low in Garden City, the rents proving sufficient to cover many public services."

The total number of men now employed on the estate is about 500.

As I have expressed it elsewhere in the official literature of the Company:—

"The Garden City Company in proposing to found a new town for industrial and residential purposes, is not entering into a land speculation; it does not desire to reap for itself the entire profit which will accrue from the conversion of agricultural land into building land, and from mere building land into the site of a well-developed town, and subject to the 5 per cent. dividend, it has carefully deprived itself and its successors of the power to do so. The Memorandum of Association of the Company provides that all profits beyond a cumulative dividend of 5 per cent., which is regarded as a fair return to the shareholders, shall be used for the benefit of the town and its inhabitants. As the profit above the 5 per cent., therefore, cannot be retained by the Company it will go to the tenants in one way or another.

As stated in a recent report of the directors of the Company, "the most critical stage in the development of a community is during that formative period before the civic life becomes crystallised, and the inhabitants have settled down to permanent occupations." With a population of over 2,000 immediately assured, having in its midst all the advantages

of city life, railway, postal, telephone, and other services, good water and gas supply, and drainage; opportunity for employment, recreation, and social activity, we may now say that the nucleus of the new town has become firmly established.

"Of one thing," said the *Spectator* four years ago:—"Of one thing we may be tolerably sure, that if a single Garden City could be prosperously established, the movement would rapidly extend."

It is thus that the Garden City movement shows the way towards the solution of those problems to which I referred in the first portion of this paper. It enables us on the one hand to get over the difficulties of dear land, congested areas, and exorbitant rates, and on the other to secure for our rural districts those social and economic advantages of which they stand so much in need.

The important question is, can the scheme be made to pay, notwithstanding its higher standard of comfort, its hygienic safeguards that cost money, without the manufacturer and his workpeople having to bear as great, if not a greater burden of rates and rents, than in existing towns? As a result of intimate experience of every step in the development so far, I do not hesitate for a moment in giving an emphatic reply in the affirmative. The extraordinary increase in land values which results from the conversion of an agricultural estate into a town site, coupled with the great saving which results from systematic planning, will not only enable the Garden City Company to ultimately pay a dividend to those who provide the capital, permit of healthy housing accommodation with gardens to be provided to the workers, but will also leave a margin to be used for the public benefit.

Owing to the higher standard of comfort aimed at in Garden City, cottages are not provided with less than four rooms and few with less than five rooms. But for the sake of comparison with the County Council schemes previously referred to, I give you the following figures shewing what would be the cost of housing in three-roomed cottages at Letchworth:—

COTTAGES, 5S. 9D. PER WEEK (FIVE ROOMS); Cost of building about £40 per room.

Maximum cost of land (capitalising the ground-rent at 25 years' purchase) ..	£15
Cost of building	£130
	£145

The rent of such a cottage would work out at from 3s. 6d. to 4s. per week, including rates, which at present are about 3s. 6d. in the £1. About five poles of land are allowed to each cottage in the above calculation, but the minimum at present allowed is about three times this amount. This compares favourably with the average of 9s. per week in London.

The proportions are, perhaps, better seen when we compare the rent per room.

London :—

Central areas	3s. 3½d.	per room.
Suburbs	2s. 4½d.	,,
Outer Suburbs......	2s. od.	,,
Letchworth	1s. 3d.	,,

When it is considered that the Garden City project not only enables us to provide accommodation at this comparatively low rate, but also does away with the necessity of the worker spending part of his earnings in travelling, some idea of the economic advantages of the scheme both to employer and *employé*, may be gained. The Garden City Company will require a considerable addition to its capital to enable it to complete the undertaking, and it is hoped that there will be no difficulty in getting the British public to subscribe what is required.

Cheap Cottages Exhibition.

To many people who are interested in rural housing, the most attractive feature of the Garden City scheme so far, has been the Exhibition of Cheap Cottages that was held at Letchworth during the past summer. Nearly all the cottages will remain as a permanent feature of the Garden City Estate.

The idea of the Exhibition was first suggested by Mr. J. St. Loe Strachey, the proprietor of *The County Gentleman and Land and Water* newspaper, with the primary object of demonstrating the practicability of erecting a five-roomed cottage for £150. One of the causes of rural depopulation is no doubt the deficiency of cottage accommodation. This deficiency is largely due to the high cost of building in rural districts, and the disabilities placed upon landlords by too exacting bye-laws. One of the objects of the Exhibition was to show how these bye-laws might be improved. As *The Times* has said, however, the cheap cottage can only be effective as an auxiliary to the Garden City movement ; considered alone it will not solve the problem, but as a part of the Garden City scheme, it is a power for great and lasting good. The Exhibition was a brilliant idea put forward at the right moment. It has inaugurated a new movement in housing reform, for no one who has witnessed the public interest called forth by the Exhibition can fail to realise that housing exhibitions have come to stay, and will continue to be a means of educating public opinion on the subject of the housing of the people.

The practical result of the Exhibition has been to prove that a cottage containing five rooms, including kitchen, scullery, and three bedrooms, the latter containing not less than 2,000 cubic feet could be erected in most rural districts from £150 to £160. Only a very few of the cheapest cottages in the Exhibition have been, or can be, put up for this amount, inclusive of profits and extras, and the greater number of the cottages exhibited as costing £150, must have cost nearly £200 on an average, including everything except land, but this is because many unnecessary extras are included, and the fact in no way disapproves the practicability of the £150 cottage.

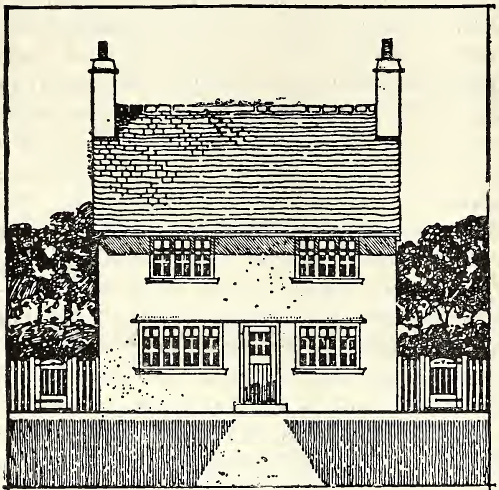
The following is the description of the First Prize Cottage, from the official catalogue, which may be taken as an example of the character of the cottages erected at the Exhibition :—

Green Bros., Whithington, near Chesterfield ; architect, Percy Houfton, Furnival-chambers, Chesterfield.

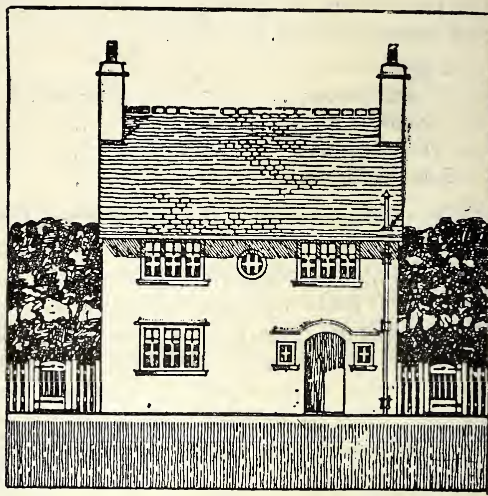
Cottage. Class 1. Cost, about £150, or about 3½d. per ft. cube. No extras. Can be duplicated for about £175, including profit, architect's fees, and men's travelling expenses. Could be erected in two months. 3½ per cent. would be saved by erecting two together ; 5 per cent. by erecting four. Ground and first floors ; living-room, with range (extreme measurements), 18 ft. by 12 ft. ; scullery, with copper, 12 ft. 3 in. by 7 ft. 6 in. ; bedrooms (extreme measurements), 18 ft. by 10 ft. 8 in., 12 ft. by 9 ft., 8 ft. 9½ in. by 8 ft. 8 in. ; larder ; cupboard-dresser and cupboard in large bedroom ; coal place and w.c. opening into outer lobby. Walls, 9-in. brickwork in mortar, cement rough cast. Floors, living-room, quarries in cement ; rest of ground floor, granolithic cement. All on 6-in. concrete bed. Roof, local red tiles. Foundations, brickwork in mortar, twice thickness of walls. Aspect of front door, north-west. W.C. Rain-water butt. Water laid on from main. 4-in. glazed, socketted, sanitary pipes, with cement joints. intercepting chamber with trap, and 4-in. inlet vent pipe and 4-in. stack carried up above roof.

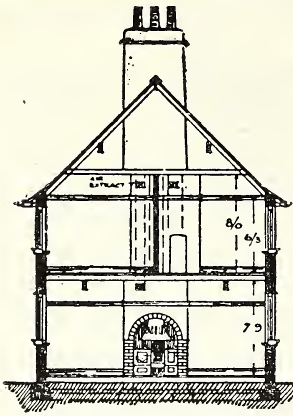
The Exhibition has made it quite clear that the cheapest cottage in a brick-producing district is the ordinary brick and slate-roofed cottage, but where bricks are scarce and dear, hollow concrete blocks or wood form equally useful and pleasing alternatives. Where cheapness is not the primary consideration, a much better effect may be obtained by the use of tiles in preference to slates, and in some districts and under certain conditions the difference in cost is immaterial. The Exhibition has also proved that the "cheap cottage

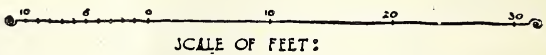
COTTAGE AWARDED THE £100 PRIZE IN CLASS I.

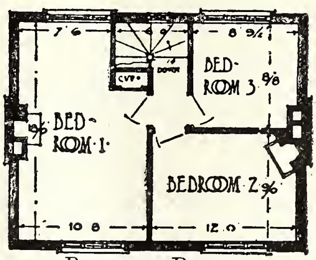


Garden.

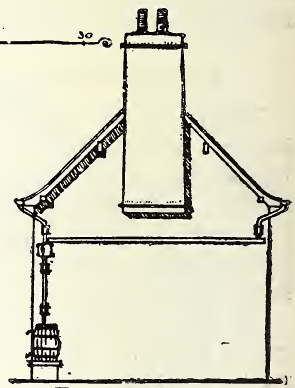




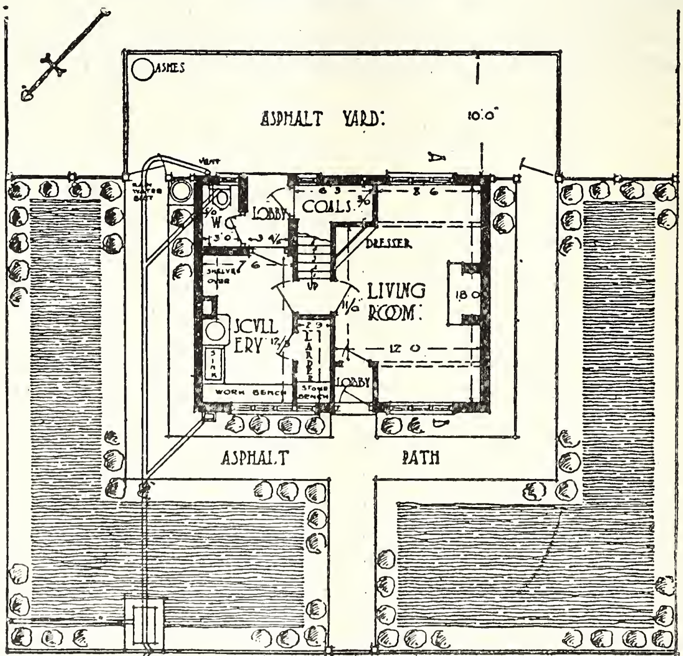




Bedroom Plan.



End Elevation.



Competition £150 Cottage. Plan of Cottage erected at Letchworth, for the Exhibition, by Messrs. Green Bros., of Whittington, near Chesterfield.

need not be nasty," but can be made a sightly and pleasing object. The variety of materials employed enables a judgment to be arrived at as to their respective values for different purposes, and, in this connection, the Exhibition proved of value to urban as well as rural housing authorities.

To revert once more to the Garden City movement, there are one or two examples to which brief reference must be made. Of these, the first in importance is Cadbury's village of Bournville.

Bournville is one of the best examples of the feasibility of the Garden City project. It is not, of course, a garden city but a garden village, and it not only proves that it pays the manufacturer to house his workpeople in healthy conditions, but that there is a real desire on the part of the working-class community to secure better conditions if the opportunity is offered to them; also that they are willing to cultivate gardens when gardens are provided. In Bournville one-half of the residents are people who have left Birmingham by choice to pay a higher rent for a house in Bournville than they paid for their three-roomed tenement in Birmingham. They come on the understanding that they have to keep their house and garden in good order, and the Bournville Trust has no difficulty in getting its tenants to act up to that condition.

Another lesson which Mr. Cadbury's experiment teaches us, is that it pays the manufacturer to move out for the simple reason that he is able to extend his works without paying a higher price for his land or compensation for business disturbance. Mr. Cadbury's works have expanded from employing 250 people twenty-five years ago to employing over 3,000 now, and his success in business is largely due to the fact that he acquired sufficient land for the purpose of expansion at the outset. It must be remembered that Mr. Cadbury's housing experiment is not based on philanthropic as apart from business principles, and the houses are made to yield a fair return upon the money invested. Mr. Cadbury himself says that it is better to carry out a large and concerted movement than for single manufacturers to move out individually.

Port Sunlight is another example of what the manufacturer can do to house his workmen on model lines, and although Mr. Lever confines the letting of his cottages to his own workpeople, and does not attempt to carry out a housing experiment in the same sense as Mr. Cadbury, he gives us an example which should be followed by all the manufacturers in the country.

On Kings Weston Estate, near Bristol, what is practically a Garden City is in course of being erected by Mr. N. P. Miles, a private landowner who owns 3,000 acres overlooking the Avonmouth docks. Mr. Miles is fully alive to the future needs of the community and sufficiently philanthropic in his business methods to plan the town which is growing up on his estate in advance, to provide spaces for schools, public buildings, and recreation, and to lay out wide tree-planted streets. What he is practically doing is to bring to bear upon the development of his property the same business principles and foresight that any captain of industry would consider necessary in conducting the affairs of large manufacturing enterprise.

Sufficient has been said to show that the Garden City project is not an attempt to create an artificial movement, but rather seeks to take advantage of a movement which already exists. The redistribution of the population will not only benefit those who remove, but also those who remain behind, as the pressure of rates and rent and the congestion will thereby be relieved in existing towns in proportion to the extent to which the people migrate to the new towns.

The benefit derived from any extensive movement of this kind would be enormous if it simply put a stop to the rural exodus without attracting any large proportion of the townspeople out. The overcrowding and congestion would be greatly relieved if the forty thousand people who drift into London every year from the rural districts had any inducement to remain in the country, such as is provided by the Garden City scheme. The extent to which this depopulation contributes to physical deterioration, will be realised from the fact that during the last ten years, two million of the population have drifted into large towns.

As a writer in the *Morning Post* has said:—"The founders of the Garden City believe the ideal of civic duty is to secure the highest comprehensive development of the race, and that sane physical as well as economic conditions must form the essential basis of such a development." They believe the principles are soundly reasoned and commend them with all faith to the consideration of all interested in the national well-being with all the strength that comes of the feeling that the project in which they are engaged has the supreme merit of being something "actually and sincerely in course of accomplishment."

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that those who came to the meeting expecting to hear that the Garden City intended to solve the difficulties in existing town systems and what was known as the agricultural question at the present moment would have been disappointed. As the author had pointed out, the idea of the organisers of the present scheme was that they should create a new industrial town, surrounded by a new agricultural settlement, recognising that nothing could be done to make absolutely good the existing towns, and to put agriculture, according to the present system, on a sound basis. That question could not be discussed at the meeting, and he suggested that such bigger problems should be left out of consideration in the discussion. But there were many other points in connection with the scheme on which he would like to obtain additional information. Many present would like to know how the author proposed to guarantee the permanence of the economic conditions on which the Garden City was based; what guarantee he could give that the capitalist would, in the future, be content with the cumulative dividend of 5 per cent.; what guarantee he would give that, if the Garden City was a success, it would be possible to purchase land in different parts of the country at as low a price as that at which it had been obtained in the present instance. Mr. Adams had referred, in the early part of his paper, to certain legislation which would be necessary to insure the permanent success of the Garden City scheme, and he would like to hear from him whether he had in his mind legislation bearing on such questions as Small Holdings and generally affecting the land question of the country, because it seemed to him that the continuation on any large scale of a system of Garden Cities depended absolutely on vital changes in the present land system of the country. There were many questions which the community in the Garden City would have to face. One was how the value of land could be equitably adjusted between the industrial and the agricultural sections of the population. The experimen which had been made in building cheap cottages had met with general approval. At the time he happened to be in a position in which many criticisms of the Exhibition were placed before him. Many dealt with technicalities which were not of general interest to the meeting, but one gentleman informed him that the whole Exhibition was useless because the space between the damp course and the wall plate was 16 feet, whereas it ought to have been 11 feet. He thought perhaps there was something in that gentleman's mind that ought to be considered. It occurred to him that in such experiments it would be useful if, not for the immediate object for which the cottages were designed but for assistance in solving the general question of housing, the experimenters had endeavoured to build a cottage at the minimum expense. If, with the difference of 5 feet, a cottage could have been built which was equally healthy, then he thought it was a pity it was not proved at the Exhibition that such a cottage could be built for £100 instead of £150. He was perhaps inclined to dwell too much on that question, as he had recently seen in one of the Colonies the people living first of all in tents, then in canvas houses, then in iron houses, and ultimately in brick houses, which, however, were in that part of the world more expensive than iron houses; but he was bound to say that they were happy and healthy in each. But in making such experiments, it did seem to one who had not lived in England all his life, that they were in danger of being influenced by the standard of luxury which was making such inroads upon the whole country.

Mr. R. A. PRICE asked if there was anything to prevent the shareholders of Garden City, Limited, by resolution proposed at a meeting properly convened, altering the memorandum and articles of association of the Company; and if not, were any steps being taken to secure the benefit of the present and future profits of the Company to the community, *i.e.*, beyond the 5 per cent., which it was proposed that the shareholders should retain for themselves.

Mr. J. A. MARKS thought the crux of the whole question was the cost of the houses built in Garden City. As far as he could learn, it was impossible to supply the agricultural labourer with a house for which at present he paid 2s. a week, or £4 or £5 a year, at a less capital cost than £150 or £200, the rent of which would be 6s. a week, or £15 12s. a year, without making any allowance for the cost of the land, and the 3d. a week for keeping the garden in order. It was also estimated that the rates would be 3s. 6d. in the pound, but he thought it would be found that that figure would have to be largely increased owing to the cost of maintaining the suggested improvements. He did not take a pessimistic view of the project; but thought it was a most worthy object, which should be supported in every possible way; but there was no doubt that enormous difficulties would have to be overcome.

Mr. HODGSON enquired whether it was a fact that the education rate on the cottages in Garden City was very high indeed. The author had referred to Mr. Lever's model town as a garden village, and not as a garden city. He would be glad to know the difference between Letchworth and Mr. Lever's town, and whether the former could truly, at the present moment, be called a city.

Mr. A. H. CAMPBELL said that he had previously heard the comparisons which the author had made as to the cost of rooms in various parts of the metropolis and other places, but to make an effective comparison, it was necessary that some standard of floor space should be adopted. The London County Council did not utilise any room that had a super-

ficial area less than 144 square feet, but in many of the other building enterprises which had been carried out, places were designated as rooms which were really not worthy of the name; they were only cabins, and contained as little as 72 square feet, in some cases, rising to 96 square feet, and about 120 square feet. He thought it would be interesting if the author, in his reply, would give a comparison of the size of the various rooms he had referred to. The establishment of Garden Cities was certainly to be commended; their originators had pursued the realisation of their ideals with most praiseworthy perseverance, and he trusted the reward which awaited all those who aimed at the improvement of the social conditions of the people would speedily come to them.

Captain SWINTON stated that the author had omitted to mention that the originator of the idea of Garden Cities was Francis, Duke of Bedford. Probably no property was ever laid out on such enlightened lines as the Bedford estate, Bedford-square, Russell-square, and the adjoining squares being laid out on the Garden City principle for the advantage of the people who lived in the district. It was so much the custom at present to hear the ground-landlords of London spoken of disrespectfully because they had not done their duty to the citizens of London that he thought it ought to be put on record that the idea of a Garden City originated with a certain Duke of Bedford.

Mr. ADAMS, in reply, said that the permanency of the economic advantages depended, to some extent, on the way the Garden City Company would transfer its interests to the community or its representatives. He thought it would be readily conceived that it would not be desirable that the transfer should be made to an Urban District Council, composed of local representatives who were interested, perhaps, in undoing the principles which the Company had established; but rather that it should be placed in the hands of a Trust, with a trust deed, under which the advantages would remain permanently for the benefit of all. The first experiment being more speculative and risky than any subsequent experiment could be, the difficulty of raising capital at five per cent. would diminish rather than increase in future. He had been asked where land suitable for Garden Cities would be obtained. It must be remembered that out of 52 million acres of land in the country, only three or four million acres were actually occupied by houses, and out of the remaining 40 or 50 million acres there was ample scope for selection. It was conceivable that the population of the country would spread very rapidly in the future over the unbuilt-upon area, and that was a reason why the growth should be controlled. A question had been asked as to the way in which the Government could assist the scheme. In the first place, they could do so by improving the present Acts with regard to agriculture and small holdings, which they could do without in any way interfering with vested interests. There was also room for improvement in the Land Laws. The Government could also assist the Garden City Company and similar enterprises by giving them the benefit of Acts analogous to those possessed by railway companies for the acquisition of land, whereby they would be enabled to purchase an agricultural estate at little over the market price in any suitable district for the purpose of building a Garden City. He largely agreed with the Chairman's remarks with regard to the question of cheap cottages. He agreed that if the present standard was improved by 100 or 150 per cent., it would be a great step forward. It must be remembered, however, that there were a large number of social reformers who insisted that not less than three bedrooms should be provided for each family, and that ideal was no doubt very desirable of attainment. At the same time, he knew as a fact that many of his own countrymen who farmed 100 acres of land, and earned from £2 to £3 a week, were living in two rooms and rearing up virtuous families. If it were possible to attain the high standard which had heen set with regard to cottages at the same rents as were paid for single rooms in London, it was very desirable that they should try and do so; but he did not think they should stand in the way of the working man who earned only 18s. or 20s. a week obtaining a cottage at a rent which had a proper relation to his wages. The important question was asked whether anything could be done to prevent the shareholders calling a meeting and altering the memorandum and articles of association of the company. The shareholders might meet and pass a resolution of that kind, but they would have to apply to the Court of Chancery for permission to make the alteration, and it was certain that permission to make an alteration of such a vital character would be refused. He was afraid that the gentleman who had referred to the cost of the house for a agricultural labourer as being £15 12s., had not followed his arguments. The £15 12s. a year actually included the land, and the Garden City did not make a charge of 3d. per week for attending to the front gardens; 6s. a week was paid by tenants for houses with three bedrooms—this being five-roomed houses—and it was possible to let off the third bedroom, and thereby reduce the amount of rent payable. In Bournville each tenant made 1s. 10½d. a week out of his garden, which again reduced the actual amount the workman paid out of his wages for rent. Taking a man who earned 25s. a week at Bournville, he not only saved the amount he usually spent in the public-house by occupying his spare time in the garden, but the actual work he thus performed brought him in another 1s. 10½d. a week; so that he not only saved what he would spend in the public-house but made about another 2s. a week which helped to considerably reduce his rent. Then a

question had been asked as to the education rate. That was a voluntary subscription, and had nothing whatever to do with the Garden City Company nor the local authority. An experiment was being made to found a school in co-operation with the County Council to provide an elementary education of the same standard as was provided in a secondary school, and those who had gone to reside on the estate were invited to give financial support if they chose, but no one was bound to pay the subscription. A small point had been raised with regard to his remarks as to a garden city and a garden village. Mr. Lever had established one industry and a village in connection with it, and he was not likely to establish more than one industry. At Letchworth, a town of 30,000 to 35,000 inhabitants was being established, with a great many different industries, and although it was hardly likely that a cathedral, which in England was the historical foundation for most cities, would be built, yet a town of this size and kind would have a good claim to the title of city. The statement had been made that the London County Council rooms contained not less than 144 square feet. The living room of the house he showed on the screen contained over 200 square feet, and the principal bedroom was of a similar size, so that the comparison, so far as Letchworth was concerned, was satisfactory. The other figures he quoted were obtained from the Report of the Traffic Commission, and he believed they were provided by the Architect of the London County Council.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Adams for his interesting paper, and the meeting terminated.

VICTORIA FALLS AND ELECTRIC TRANSMISSION.

Attention was directed in a recent number of the *Journal* (December 29, 1905) to the efforts being made by the African Concessions Syndicate to put into practice an electric transmission scheme from the Victoria Falls to the Rand. When in Johannesburg in August last Professor W. E. Ayrton gave a lecture upon the project, in which the opinion was expressed (1) that electric transmission of power from the Falls to Johannesburg is feasible from an engineering point of view; (2) that M. Therry's constant direct current system of transmission would be the best if it were advisable to carry out any system; (3) that such transmission could not pay because at present there is not sufficient demand for power along the route to justify the expenditure of capital necessary. In the Engineering Supplement of *The Times* of November 22, Professor Ayrton repeated the opinions expressed in his lecture, and traversed the opinion of Mr. Wilson Fox, the manager of the British South Africa Company, that the scheme would be a commercial success. Professor Ayrton's article gave rise to an interesting controversy in the columns of *The Times* in which Mr. Wilson Fox, Mr. Thomas A. Davies, Professor Kapp, M. Blondel, Mr. Robert Hammond, and others, have taken part. Professor Ayrton has satisfied himself that at a price of 10s. to 12s. per ton really excellent coal can be obtained and delivered on the Rand, and that with coal at this price it is impossible to transmit electric energy 745 miles and sell it more cheaply than it can be obtained from coal on the spot. Professor Ayrton points out that the cost of Niagara energy delivered in Buffalo, only 30 miles away, comes to £25 11s. per horse-power year, which is more than the present price at the mines on the Rand, and supplied locally, and that it would be impossible to deliver electrical energy at a distance of 745 miles at the cost at which it is being delivered only thirty miles from Niagara. What has led to the great success of the Niagara Falls Power Company is not the transmission of power to considerable distances, but the fact that in the immediate neighbourhood of the Falls there have grown up works which take some 60,000 horse-power, "works which not only want cheap power, but power in an electric form, for electro-chemical processes, and need it in an undiminished amount day and night, week-day and Sunday." In South Africa, in Professor Ayrton's opinion, there can be no demand of this kind, at least for many years to come.

Mr. Wilson Fox rests his case for commercial success upon the opinion of many well-known experts, Professor Kapp, M. André Blondel, Dr. Edouard Tissot, Sir Douglas Fox, and Partners, &c., and says that Professor Ayrton is mistaken in assuming the average cost of power upon the Rand to be £25 per horse-power per 24 hours per annum, that being the minimum, and "at most mines the cost exceeds £40 per annum." Mr. Thomas A. Davies says that to be successful, "electrical energy must be supplied to the mines at not more than £30 per horse-power per annum, having in view a possible annual demand of 100,000 horse-power," and that it has not been shown that this can be done. Professor Ayrton, in a rejoinder to Mr. Fox, quotes the opinion of Mr. H. C. Behr, who has the reputation of being one of the ablest mining engineers on the Rand, in proof of his statement as to the cost of energy at Johannesburg. Professor Kapp writes to say that he has "never been asked to pronounce an opinion on the commercial success, or otherwise, of the Zambesi scheme," and M. Blondel says his opinion "was chiefly given from a technical point of view." He does not think the data at present available adequate to form an opinion as to the commercial success of the scheme. And Mr. Robert Hammond, another high authority, submits calculations which lead him to conclude that "Mr. Wilson Fox's scheme saves £91,875 per annum, plus a small sum to cover other minor savings, and in order to do it the annual expenditure of £200,000 is necessary." On the other hand, Mr W. B. Eason thinks that

"judging from data so far to hand, there is every reason for believing that the proposal to utilise the Falls of the Zambesi on a 80,000 h.p. scale is economically sound, and that its realisation would be commercially succesful."

THE CHINESE SALT INDUSTRY.

The methods followed in salt making along the northern coast of China are very antiquated, and in consequence a large quantity of impure salt is annually placed on the market. It would seem that the salt-making districts of China present a good field for the introduction of modern machinery. At different points on the coast of North China, extending from Tongku to Shanhaikuan and Nieuchwang, many tons of impure salt are made each year. The methods employed are the same in each place, and the same have been in use certainly from the time of Marco Polo's famous journey through Eastern China. The salt is made by the evaporation of sea water. The water is pumped into the evaporating basins by wind power, and evaporated by the heat of the sun. Extending many miles each way from Tongku the coast is nearly level, and only a few inches, or feet above high tide. On this flat coast are the salt works. The United States Consul at Tientsin says that the evaporating basins are made on the flats, and have much the appearance of innumerable tennis courts of great size. They are separated from each other by small ridges of mud, about eight inches high. The bottom of the basins are made level, and hard rolled with a stone roller. The basins are filled to a depth of three inches with sea water, which is evaporated by the heat of the sun in from one to three days, leaving a coating of salt at the bottom. This is carefully scraped into a pile, and after re rolling the bottom, more water is pumped in. These basins are placed about two feet above tide level, and in groups, so as to be served by a central pump. The flats are cut in all directions by small canals, giving each group water connection with the main salt yards at the railway station or the river. The salt as fast as it is made is shovelled into small boats, which are punted through the canals to the main yards, where it is thrown into great heaps and covered with mats, waiting to be sold and packed for the Tientsin market. The windmills used for pumping the salt water into the basins are most ingenious, and of a type met with only in China. There is a light hexagonal wooden frame fastened to a central post. On this frame are set six small sails of cotton cloth, with the booms so fastened as to allow them to swing out at an angle of about 45 degrees. To the bottom of the post is attached a horizontal cog-wheel which fits into the vertical cogs of a horizontal shaft. The outer end of this shaft works the pump, which is of the disc type. There is an endless chain, on which are vertical wooden discs about 5 inches by 9 inches and 9 inches apart. These discs run in a rectangular trough 9 inches wide and 5 inches deep, open at both ends. The lower end of the trough is submerged in the salt water, and the upper end is above the small ditches which supply the evaporating basins. This trough may be 10 feet to 20 feet in length, depending upon the height to which the water is to be raised, and usually has a slope of about 20 degrees with the horizontal. At the upper end of the trough the disc chain passes around the horizontal shaft from the windmill, and this shaft is provided with sprockets which fit between the discs. With the revolution of the windmill the shaft revolves, and the chain with the discs travels up the trough, each disc pushing its complement of water to the top, where it falls into the small ditches and runs off to one or the other of the many evaporating basins. The amount of water pumped depends of course, upon the speed of the windmill, and is from 1,000 to 5,000 gallons per hour. These mills are erected in groups of three (a small plant) or five (a large plant), and there are about 250 mills which feed the collection depôts near Tongku. The mills turn out about 700 tons of salt per mill per year. They cannot be worked during rainy or frosty weather, and are consequently idle more than half the time. The windmills and pumps are constructed entirely of wood, and their action is automatic. They require but little attention and can easily be repaired. The making and selling of salt is a Government monopoly and a most valuable one. The position of "salt taotai" of Tientsin is one of the most lucrative Government positions in China. The groups of mills belong to individuals who have purchased a Government permit for their erection. All the salt made must be delivered to the Government collecting stations, for which the maker receives a price just sufficient to keep him at work. There are in Tientsin four large salt depôts for local consumption, which handle about 100 tons per month each. Of the annual salt production in the Tongku region, about 80,000 tons are consumed in the Province of Chihli, and 76,000 tons in the Province of Honan. Following north along the coast there are considerable quantities of salt made at the towns of Lanchow, Changli, and Shanhaikuan. Up to about two years ago there was no Government tax on this salt. The approximate annual production of salt in the Tongku region is 161,000 tons, of which the Province of Chihli produces 80,000 tons, the Province of Honan 76,000, and Tientsin and its vicinity, 5,000 tons.

UTILISATION OF VEGETABLE PRODUCTS.*

Australia offers a vast and practically inexhaustible field for those experienced in the industrial utilisation of vegetable products. Although the practical value

* Communicated by Mr. John Plummer, of Sydney.

of economical botany remains imperfectly understood throughout the Commonwealth, there are not wanting indications of its approaching recognition as a new and valuable source of national wealth. Some few months ago, Mr. R. T. Baker, F.L.S., curator and economical botanist of the Sydney Technological Museum, appeared as a witness before a Royal Commission appointed to enquire into the condition of the western lands of New South Wales. In the course of his examination, he produced samples of eucalyptus oil in various stages, extracted from trees in the eastern portions of the State, remarking that they were of the highest quality, fully equal to the best in the market. A vast amount of research had lately been made in connection with the Australian flora, with very valuable results. For instance, myrticolorin, a new dyeing material, had been obtained from the leaves of the red stringy bark, in addition to the valuable oil extracted from the same source. This dye, which was not yet on the market, gave a lighter and better colour than the American quercitrin, obtained from the bark of an American oak, and consequently might be regarded as a by-product, likely to prove of commercial importance. A quantity of the dye had been sent home to the leading manufacturers in England and Germany. The manufacturers in England were delighted with the results, and sent back several specimens of cloth, showing the beauty and utility of the dye.

Out of trees and shrubs in the eastern portion of the State, Mr. Baker had, with the assistance of his staff, extracted camphor, perfumes (such as otto of roses, ionone, and cinnamon), dyes, and peppermint, and cajuput—oils which ought now to be pushed on the market. The camphor, in fact, was identical with the camphor of commerce, and was taken from the tree known as *Cinnamomum oliveri*. The Commonwealth could also compete against India and Bulgaria with its geraniol extract, for the reason that it combined several products, such as perfumes, which in the countries mentioned had to be manufactured separately. The very fact that the Buddah tree, so common as a parasitic growth in the dry interior districts, spluttered and showed good resinous qualities when burned, went to prove that it held a marketable commodity which might prove of great commercial value. Apart from the trees and shrubs mentioned, the Commonwealth is rich in others capable of being utilised for industrial purposes. Yellow dyes are furnished by the fever bark, cedar, cockspur vine, light yellow wood, *Mallotus discolour* crab-tree, and turmeric tree; red dyes by scrub, or brush bloodwood, red cedar, bloodwood, *Mallotus phillipensis*, and mangrove; brown from the brigalow, Queensland carscarilla, fustic, bitter bark, *Pipturus argenteus*, and satin wood; purple from *Hymenanthera dentata*; sap green from the musk tree, and black from messmate, or stringy bark. Many other vegetable dyes might be mentioned.

Essential oils are obtained from the native sassafras, ridge myrtle, tea tree, native peppermint, Queensland sassafras, native laurel, dogwood, sandfly bush, and all the nnmerous varieties of eucalyptus, the oil from which is credited with possessing the power of destroying bacteria or animal life, and may be classed with antiseptics, having an advantage over carbolic acid in the fact that it is not caustic. For medicinal purposes eucalyptus oil has no equal. The richest oil is obtained from the mountain ash, which is found in Victoria, Tasmania, South Australia, and New South Wales. The Victorian blue gum also furnishes an excellent oil. The Australian resin-producing trees include the Moreton bay pine, sassafras, pinkwood, Port Jackson fig, various kinds of pine, silky oak, beefwood, sandalwood, turpentine tree, grass tree, and Cheesewood. Gums and gum resins are obtained from the candle nut, buny-bunya, pinkwood, native banya, and various kinds of acacia and grass tree. Wattle gum is largely exported for the manufacture of mucilage, cotton printing, and other purposes, being somewhat similar to gum arabic.

Kinos, or vegetable extracts, are obtained from the narrow-leaved appletree, brush bloodwood, christmas bush, white mahogany, cider gum, white box, leather jacket, and other kinds of eucalyptus. In tanning materials the Commonwealth is marvellously rich, a fact which explains the high character of properly made Australian leather. All the wattle and other varieties of acacia furnish abundance of bark for tanning purposes, and are easily grown, the black, green, or golden wattle furnishing one of the richest tanning barks in the world. The bark of the sassafras, coast honeysuckle, red ash, red mangrove, belar, blue fig, emu bush, messmate, yellow box, native cherry, quandong, pin bush, and many other trees, also furnish useful barks.

CHINESE IN FOREIGN LANDS.

Much interest appears to have been attracted in China recently by the publication of statistics of Chinese emigration. According to these statistics, the source and authority of which cannot be well established, the total of Chinese in foreign countries is 7,642,650, distributed as follows: —Formosa, 2,000,000; Siam, 2,500,000; Malay Peninsula, 985,000; Sunda Islands, 600,000; Hongkong, 274,534; all America, 272,829; Indo-China, 150,006; Philippines, 80,000; Macao, 74,568; Burmah, 40,000; Australia, 30,000; Asiatic Russia, 25,000; Japan, 7,000, and Korea, 3,713. It is not claimed that these figures are accurate, the admission being freely made that they are approximate and that they are now subject to considerable revision. They are, however, being used to show that only about 2 per cent. of China's estimated population has emigrated, and that remote nations have no cause for complaint on the score of Chinese invasion.

HOME INDUSTRIES.

Consuls and Trade.—It was mentioned in these notes last week, that the German Government has just issued further instructions to their Consuls respecting the assistance to be rendered to merchants and manufacturers wherever possible, and it may be noted that a Bill is now before the American Senate having for its object the reform of the American Consular Service, a Bill suggested by Secretary Root, and introduced by Senator Lodge. As finally amended by the Senate Committee on foreign relations, it classifies and grades the offices in the service, makes provision for the employment of inspectors of Consulates to examine the offices once in two years, prohibits Consuls from engaging or being interested in any business, does away with the fee system, and provides for a more uniform scale of invoice charge. There is a general impression that Sir Edward Grey is likely to introduce considerable changes into our own consular service; and that it might be made of much more assistance to British trade than it can be said to be at present.

The "Cash on Delivery" System.—It may be remembered that some fifteen months ago there was considerable discussion as to the merits of what is known as the "Cash on Delivery" system, which the Post Office authorities proposed to work. The then Postmaster-General, Lord Stanley, was strongly in favour of it, but a loud outcry was made by the provincial retail dealers, and ultimately the scheme was withdrawn, so far as the United Kingdom is concerned. The main objection taken by provincial traders was that if the proposed system was introduced the large London houses would gain at the expense of country dealers, already heavily handicapped by London competition. The system was said to have worked well in France and elsewhere, but the agitation against the proposed extension of Post Office activity was so great that the Postmaster-General ultimately decided not to go on with it whilst holding himself free to apply it to India and the Colonies. A Departmental Committee was appointed to consider the details essential to the establishment of a "Cash on Delivery" system between the United Kingdom and British colonies, but this committee has not yet reported. Meantime, French shopkeepers seem to be working the system to advantage. According to the Alexandria commercial correspondent of *The Times*, during 1904 12,180 post-parcels were received in Egypt from France under the "Cash on Delivery" system, and their total value amounted to £22,700, an average of about £1·17 per parcel. In two years the French retail shopkeepers more than doubled this particular class of trade with Egypt, and they are rapidly extending it.

Shipbuilding on the Thames.—In his interesting address at the opening of the London County Council School of Marine Engineering, Poplar, Sir William White had no difficulty in showing that shipbuilding on the Thames has dwindled in recent years to insignificant proportions. In 1905 the total output on the Thames was less than 12,500 tons distributed over 138 vessels, whereas on the Clyde over 540,000 tons were launched, on the Tyne 350,000 tons, on the Wear 317,000 tons, and at Belfast over 140,000 tons. Nor did Sir William White's explanation of this declension of London shipbuilding differ from that generally given. He enumerated among the circumstances that have caused the change, the geographical position of the Thames in relation to the great coal and iron-producing districts of the country, the high value of land, the incidence of local taxation, and the high rate of wages obtained by Thames workmen. But he also directed attention to another circumstance to which great importance is attached, although it is often overlooked, namely, "the enormous amount of ship repair work which necessarily has to be done in the port of London." Men can earn very large wages on this class of work, and consequently can enjoy more leisure and recreation than when they are continuously employed on new shipbuilding, and this fact has influenced the course of events in connection with shipbuilding on the Thames, and assisted to diminish, and almost destroy, a great industry.

The Output of the United Kingdom.—But if shipbuilding is disappearing from the Thames, the total output of the United Kingdom is well maintained. "Lloyd's Register of Shipping" shows that during 1905, exclusive of warships, 795 vessels of 1,623,168 tons gross were launched in the United Kingdom. The output of mercantile tonnage during the year shows an increase of no less than 418,000 tons on that of 1904, and is the highest on record, the previous record tonnage for merchant vessels being 1,524,739 in 1901. The tables show the overwhelming preponderance of steel, 99·9 per cent. of the tonnage launched being built of steel, and 98·87 per cent. being composed of steam tonnage. The shrinkage of sailing tonnage continues. Of the total output of tonnage built for registration in the United Kingdom, 1,261,316 was steam tons, and only 12,415 sailing tons. Whilst during 1905 the steam tonnage of the United Kingdom increased by 592,000 tons, the sailing tonnage decreased by about 123,000 tons. The net increase of the United Kingdom tonnage was about 469,000 tons, which is considerably more than the average of the past five years, although the increase in 1902 was no less than 643,000 tons. The foreign demand for British-built ships shows no signs of diminution. On the contrary, in 1905, $21\frac{1}{2}$ per cent. of the total output of British yards was acquired by foreign and colonial shipowners, as compared with $18\frac{2}{3}$ per cent. in 1904, and 18 per cent. in 1903 and 1902, Germany taking 15 vessels of 85,020 tons, nearly $5\frac{1}{4}$ per cent. of the total output, notwithstanding the great activity and expansion of her own yards.

The Increasing Size of Ships.—The Tables for 1905 give striking evidence of the increasing size of ships, a fact which emphasises the need for early grappling with the deficiences of the port of London. At the present time there are, under construction, 37 vessels of 6,000 tons and upwards, of which eight are of over 12,000 tons each. The four largest steamers launched in the United Kingdom during 1905 were of 22,724 gross tons, 19,524 gross tons, 17,100 gross tons, and 14,500 gross tons respectively; but the largest steamer built in the world in 1905 was the *Kaiserin Augusta Victoria*, of 26,000 tons, launched at Stettin. Germany also launched the largest sailing vessel of the year, namely, the *Pamir*, of 3,020 tons. The net increase of the world's mercantile fleet in 1905 was about 1,790,000 tons, but the sailing tonnage of the world was reduced by 187,000 tons, so that steam tonnage has increased by 1,977,000 tons, the proportion of this total accruing to the United Kingdom being 592,000 tons or 30 per cent. The Tables shew steady increase in the employment of the turbine method of propulsion. During the year seven vessels, fitted with steam turbines, were launched in the United Kingdom, and in addition to the two large express steamers for the Cunard Company there are, at present, under construction in the United Kingdom, ten vessels of 21,000 tons, to be fitted with steam turbines.

Gold Production in 1905.—If Mr. Frederick Hobart's estimate is correct—and it is that of a high authority on the subject, and is accepted by Bradstreet—the gold production of the world in 1904 added to its wealth 375,465,810 dols., say £75,093,162 sterling. In 1904 the output—taking 5 dols. to the £—was £69,453,413, so that there was an increase in the value of the gold production last year of £5,639,749. And this is mainly accounted for by the growth of the output in the Transvaal alone, which was no less than £4,634,652. Of the £75,093,162, £44,062,222, say nearly 59 per cent. was produced within the British Empire. If to this is added the yield by English-owned mines in foreign countries, the percentage would be 69 per cent., and if the United States are included the English-speaking people produce nearly seven-eights of the world's gold.

The Chief Gold-producing Countries.—In 1904 Australia headed the list of gold producers with an output valued at £17,420,170, the United States coming next with £16,144,600, and the Transvaal third with £15,624,540. Last year the Transvaal was well in front of the rest of the world with £20,259,192, the United States taking second place with £17,267,540, and Australia falling back to third place with £17,104,425. In the following Table, which gives Mr. Hobart's figures, reduced to sterling, the amounts contributed by the leading producing countries in the two years 1904 5, will be seen at a glance :—

	1904.	1905.		Charges.
	£	£		£
Australia	17,420,170	17,104,425	—	315,745
British India	2,320,493	2,326,880	+	6,387
Canada	3 280,000	2,883,625	—	396,375
Mexico	2,521,060	2,700,000	+	178,940
Russia	5,015,071	4,800,000	—	215,071
Rhodesia	964,045	1,485,925	+	521,880
Transvaal......	15,624,548	20,259,192	+	4,634,652
United States	16,144,640	17,267,540	+	1,122,900
All others ...	6,163,371	6,263,400	+	100,026

These figures show that by far the most remarkable increase is that of the Transvaal. In 1904 it slightly exceeded the output of the last full year's working under the Republic, namely, that of 1898, which amounted to £15,141,376, last year it exceeded it by £5,117,816, and it is quite possible that 1906 may see an output not very far short of £25,000,000. The output of Rhodesia shows substantial improvement, and it now ranks eighth among the gold-producing regions of the world.

Other Gold-producing Countries.—Efforts are being made to start, or develop, the gold mining industry in many parts of the world, but as yet these efforts have not been attended with any striking success. Much has been said of late about West Africa as a gold-producing region but the deadly climate, the want of roads and railways, and the lack of labour make the outlook very doubtful, and shareholders in the numerous companies formed to work in this region have to reckon with great risks. In the Soudan efforts are being made to start gold mining but as yet with indifferent success, and the public will do well to heed Lord Cromer's warnings. It was thought at one time that the French occupation of Madagascar would be quickly followed by a great development of the mining industry of the island, but the gold output remains quite insignificant, and so with the Malay Peninsula, and the Dutch Indies. There are said to be valuable quartz reefs in the north of China, and Korea is thought to have rich gold regions, but little has been done in the way of development in either country. Mexico is a great mineral country, and the number of its important gold mines is growing, but possibly its copper, and silver are more important assets. There are valuable gold mines in Brazil and Columbia, but capital has fought shy of Central and South American Republics. The climate of New Guinea prevents any great development of mining industry, and in New Zealand the payable quartz mines are few. Given restoration of order, Russia may be expected to increase her gold output more rapidly than any other country with the exception of the Transvaal, and possibly the United States, where improved methods have led to the re-working of low grade mines. It is curious to note that the substantial output of India continues to come from some five miles of reef.

GENERAL NOTES.

Belgian Hothouse Grapes. — About forty years ago, the cultivation of grapes under glass was practised on a small scale at Hoeylaert, a village near Brussels, more as an experimental venture than as a business enterprise. From the beginning, the experiment was attended with success, and from its small origin, this method of cultivation rapidly developed until it now ranks as one of the most flourishing and lucrative industries in the neighbourhood of Brussels. To-day, there are no less than 10,000 hothouses in the immediate vicinity of the capital. These hothouses are usually from 65 to 82 feet in length, and about 26 feet in width. Heat is distributed through clay pipes. The principal varieties of grapes, are as follows:—"Frankenthal," a blue medium sized grape of fine flavour, and very juicy; "Big Colman," an immense purple grape of attractive appearance, somewhat too solid and lacking in juice; and the "Black Alicante" and "Queen Victoria," both acceptable as to quality and flavour. These grapes are sold on the Belgian retail markets all the year round, at prices, varying with the seasons, from about sevenpence to four shillings a pound. In the last few years, the cultivation of peaches, in connection with grapes, has also become very profitable, and although still practised on a limited scale has produced excellent results. The cultivation of strawberries, tomatoes, spinach, lettuce, asparagus, and chicory under glass is also carried on by syndicates, which regulate production as well as prices. The grapes grown, are exported largely to England, Germany, Russia, and Denmark, and occasionally in small quantities to the United States.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

February 7.—"Progress in Electric Lighting." By Leon Gaster, A.M.I.E.E. Sir William Preece, K.C.B., F.R.S., will preside.

February 14.—"The Horseless Carriage, 1885–1905." By Claude Johnson. Colonel H. C. L. Holden, R.A., F.R.S., will preside.

February 21.—"The Fisheries of the North Sea." By Walter Garstang, M.A. Edwin Ray Lankester, M.A., LL.D., F.R.S., will preside.

February 28.—"London Traffic." By Captain G. S. C. Swinton (L.C.C.). Sir John Wolfe-Barry, K.C.B., LL.D., F.R.S., will preside.

March 7.—"The Artistic in Painting and Photography." By J. C. Dollman, R.I.

March 14.—"Imperial Organisation from a Business Point of View." By Geoffrey Drage.

Dates to be hereafter announced:—

"The Preparation of Oxygen from Liquid Air." By Monsieur Raoul Pictet.

"Submarine Signalling." By J. B. Millet.

"The Supply of Electricity." By James N. Shoolbred, B.A., M.Inst.C.E.

"Industrial Russia." By Lucien Wolf.

"Motor Boats." By Bernard B. Redwood, B.A.

"The Production and Collection of the Picture Postcard." By Frederic T. Corkett.

"Power Transmission and Coal Conservation." By Arthur J. Martin, Assoc.M.Inst.C.E.

"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By Professor Thomas Oliver, M.D., LL.D.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

February 15.—"The Navigable Waterways of India." By Robert Burton Buckley, C.S.I.

March 15.—Dr. George A. Grierson, C.I.E., Ph.D., D.Lit., "The Languages of India and the Linguistic Survey."

April 26.—Colonel Sir Arthur Henry McMahon, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

May 24.—Major Percy Molesworth Sykes, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

February 6. — "Imperial Immigration." By Octavius Charles Beale, President of the Federal Council of the Chambers of Manufactures of Australia. The Right Hon. the Earl of Elgin, K.G., G.C.S.I., G.C.I.E., will preside.

March 6.—"Imperial Questions in the West Indies." By Sir Nevile Lubbock, K.C.M.G.

May 1.—"Social Conditions in Australia." By the Hon. J. G. Jenkins, Agent-General for South Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock:—

February 20.—"Illuminated Manuscripts." By H. Yates Thompson, F.S.A. The Hon. F. W. Fortescue, King's Librarian at Windsor Castle, will preside.

March 20.—"English Royal Heraldry." By Cyril Davenport, F.S.A. William A. Lindsay, K.C., Windsor Herald, will preside.

April 24.—"Cut Glass." By Harry Powell.

May 24.—"Basket Making." By Thomas Okey.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

Sir William White, K.C.B., F.R.S., "Modern Warships." Five Lectures.

Lecture II.—February 5.—Armour protection—Systems of disposition—Methods of manufacturing armour plates—Recent improvements in quality, and consequent changes in designs of warships.

Lecture III.—February 12.—Armaments—Progress in the design and manufacture of guns, mountings and machinery for working heavy guns—Improvements in projectiles and explosives.

Lectures IV. and V.—February 19 and 26. —Recent types of warships, British and Foreign—Battleships — Armoured and protected cruisers—Scouts—Torpedo boats and destroyers—Submarines.

Prof. Vivian B. Lewes, "Fire : Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

Alfred Maskell, "Ivory." Three Lectures.

April 23, 30, May 7.

George W. Eve, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

Howard Lectures.

Thursday evenings, at 8 o'clock :—

Professor Silvanus Thompson, D.Sc., F.R.S., "High Speed Electric Machinery, with special reference to Steam - Turbine Machines." (Three Lectures.)

Lecture III.—February 1.—*Turbo-alternators.* —Relation between frequency, number of poles, and revolutions per minute—Relation between frequency, surface-speed, and pole-pitch—Turbine speeds and field-magnet design — The limitations of magnet design — Balancing — Armature - design in alternators — Nature of armature reaction—Armature-design as affected by power-factor of the load—Mechanical considerations — Ventilation of turbo-alternators—Forced ventilation—Efficiency; overload possibilities; limits of design—Excitation of field-magnet system—Preference given to very low voltage of excitation—Examples of turbo-alternators.

MEETINGS FOR THE ENSUING WEEK.

Monday, Feb. 5...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Sir William White, "Modern Warships." (Lecture II.)

Farmers' Club, 2, Whitehall-court, S.W., 4 p.m. Mr. A. H. H. Matthews, "Agriculture and Parliament."

Royal Institution, Albermarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Inaugural Address by the President, Mr. Maurice Wilson.

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. J. K. H. Inglis, "The Loss of Nitre in the Chamber Process." (Part II.)

British Architects, 9, Conduit-street, W., 8 p.m. Presidential Address to Students.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Professor J. Logan Lobley, "Biological Changes in Geological Time."

London Institution, Finsbury-circus, E.C., 5 p.m. Mrs. E. Burton-Browne, "The Development of Sculpture in Greece and Rome."

Society for the Encouragement of Fine Arts, 6½ Suffolk-street, Pall-mall, S.W., 8¼ p.m. Musical Lecture by Mr. Pascal Needham.

Tuesday, Feb. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. Octavius Charles Beale, "Imperial Immigration."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. Stirling, "Food and Nutrition." (Lecture I.)

Alpine Club, 23, Savile-row, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Frederick Robert Upcott's paper, "The Railway-Gauges of India."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. H. W. Bennett, "Cathedral Photography."

Zoological, 3, Hanover-square, W., 8½ p.m.

Wednesday, Feb. 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Leon Gaster, "Progress in Electric Lighting."

Geological, Burlington-house, W., 8 p.m.

Public Analysts, Burlington-house, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m. Annual Meeting.

Thursday, Feb. 8...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. F. J. Sawyer, "The History of England as Taught in its Songs."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. B. Kidd, "The Significance of the Future in the Theory of Evolution." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. F. W. Carter's paper, "Technical Considerations in Electric Railway Engineering." 2. Mr. Claude W. Hill, "Crane Motors and Controllers."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Friday, Feb. 9...Royal Institution, Albermarle-street, W., 9 p.m. Mr. H. E. Newall, "Eclipse Problems and Observations."

Civil Engineers, 25, Great George street, S.W., 8 p.m. (Students' Meeting.) Mr. R. H. Mackie, "Electric Driving at the Locomotive-Works of the North London Railway."

Astronomical, Burlington-house, W., 5 p.m. Anniversary.

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Rev. G. R. West, "Difference between English and French Gothic Art."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 8 p.m. Annual Meeting.

Saturday Feb. 10...Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. W. Gordon, "Advances in Microscopy." (Lecture II.)

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FRIDAY, FEBRUARY 9, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 12, 8 p.m. (Cantor Lecture.) Sir WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." (Lecture III.)

WEDNESDAY, FEBRUARY 14, 8 p.m. (Ordinary Meeting.) CLAUDE JOHNSON, "The Horseless Carriage—1885-1905."

THURSDAY, FEBRUARY 15, 4.30 p.m. (Indian Section.) ROBERT BURTON BUCKLEY, C.S.I., "The Navigable Waterways of India."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

SIR WILLIAM WHITE, K.C.B., F.R.S., delivered the second lecture of his course on "Modern Warships," on Monday evening, February 5th.

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, February 6; SIR WESTBY B. PERCEVAL, K.C.M.G., in the chair. The paper read was "Imperial Federation," by OCTAVIUS CHARLES BEALE, President of the Federal Council of the Chambers of Manufactures of Australia.

The paper and report of the discussion will be published in a future number of the *Journal.*

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

TENTH ORDINARY MEETING.

Wednesday, February 7; SIR WILLIAM H. PREECE, K.C.B., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Basden, Albert Edward, Lieutenant Governor's Office, P.O. Box 438, Pretoria, Transvaal, South Africa.
Boyce, Framroze Hormusji, near Fire Brigade Station, Fort, Bombay, India.
Busteed, Brigadier-Surgeon Henry Elmsley, C.I.E., M.D., care of Messrs. H. S. King and Co., 9, Pall-mall, S.W.
Chacon, Francisco, Spanish Royal Naval Commission, 65 and 66, Chancery-lane, W.C.
Coutts, Ernest Gray, Indus Bridge at Kushalgarh, N.W. Province, India.
McNaught, James, Lumding, A.B. Railway, Assam, India.
Terry, Rev. Charles John, M.A., 15, Hyde-gardens, Eastbourne.

The following candidates were balloted for and duly elected members of the Society:—

Bayliss, Alderman Thomas Richard, J.P., Belmont, Northfield, Worcestershire.
Berridge, Mrs. Agnes, 49, Rutland-gate, S.W.
Cadbury, Barrow, Southfield, Wheeley's-road, Birmingham.
Clark, Charles James, A.R.I.B.A., 46, High-street, Bloomsbury, W.C.
Eaton, Edmund, Battenhurst-park, Ticehurst, Sussex.
Frost, Joe, A.M.I.E.E., 4, Peking-road, Shanghai, China.
Hankin, Dr. E. H., M.A., Office of Chemical Examiner and Bacteriologist, Agra, India.
Marshall, Mrs. A. Campbell, Freshfield, Waterloo-ville, Cosham, Hants.
Reckitt, Miss Juliette, Mayfield, Dulwich-wood-park, S.E.
Robson, Thomas Conyers, P.O. Box 946, Pretoria, Transvaal, South Africa.
Woltereck, Herman C., Ph.D., 3, Edinburgh-mansions, Howick-place, Westminster, S.W.

The paper read was—

THE PROGRESS IN ELECTRIC LIGHTING.

By Leon Gaster, A.M.I.E.E.

The great interest the Society of Arts has taken in the development of electric lighting from its early stages, together with the fact that the public are now paying greater attention to the merits of electric lighting *versus* other illuminants, justify me in bringing before you the above subject for consideration.

The particular object that I have in view in asking the Society to discuss this subject is that the requirements of the much neglected and abused consumer may be brought into greater prominence than has been the case in the past, for I would point out how his requirements can be fulfilled if the lamp manufacturers and central station engineers will only co-operate by trying to meet each other on the common ground of the public need for an improved and more efficient electric lighting service.

The chairman of to-night has contributed to this Society over half-a-dozen valuable and instructive papers on the same subject, the first of which was read as early as 1881, when very little was known by others about the use of electricity for electric glow-lamp lighting. The progress made in the 22 out of the 26 years since it was first introduced has not been relatively so great as it has been during the last few years. Much greater progress is therefore reasonably to be expected in the next decade, in the first place owing to a better understanding of the principles governing the conversion of electrical energy into light, and secondly, on account of the assistance now afforded by electro-chemical methods and by the higher temperature obtainable with the electric furnace for the manufacture of filaments.

I will not dwell upon the great progress made in the methods of generating electrical energy in the last 25 years, which have led up to the present use of large steam turbines of 10,000 h.p. units, or of large steam and gas engines which were never dreamt of 25 years ago, but I will for our purpose imagine that the current is brought into the house of the consumer, and is there to be used for the conversion of electric energy into light. I will try to describe to you as briefly as possible the present manufacture of incandescent lamps, and I must apologise to those members who have listened to the admirable papers read before in this same room, for I am afraid they may not hear much new information regarding this subject. The only difference is that the complaint raised on previous occasions by several speakers regarding the inefficiency of incandescent lamps and the unreliability of their marking could not then easily be met, whereas to-day there is a chance owing to the foundation of the National Physical Laboratory and the existence of the Engineering Standards Committee that our requirements will be realised at an early date.

I will throw upon the screen a few lantern slides showing the present methods of manufacture of carbon filament lamps. The slides have been kindly lent to me by the directors of the Robertson Electric Lamp Company, and they have also lent a show-case, which you will have the opportunity of inspecting, showing the different parts necessary in the manufacture of a lamp.

In describing briefly the different processes which have to be undergone by a lamp before it is completed, you will see that only by due care in the manufacture, and by taking the necessary precaution to test the lamps in the different stages of manufacture, can a satisfactory result be obtained. Those members who were present at the excellent lecture delivered by the late Major-General Webber in these rooms on December 10th, 1886, when he exhibited the actual manufacture of lamps as then used by the Anglo-American Brush Electrical Corporation, will notice that progress has been chiefly made in the direction of cheapening the production by the use of improved mechanical methods, and by trying to make lamps of higher efficiency.

The first slide shows the filament-making room, where cotton is used as raw material and is dissolved in chloride of zinc; this process is used at the Robertson Works. The successive slides show—the squirting of the filament into vessels containing alcohol, the bath for washing, winding, drying, making and gauging the filaments—the latter process requires great accuracy—if the lamps turned out have to be of a given voltage and of certain candle-power and efficiency. The mounting and joining of the filaments to the leading-in wires, the process of depositing carbons over the joint between the filament and platinum wire, the flashing operation the glass blowing and exhaustion of the bulbs by the use of the Sprengel vacuum pumps, and by other systems adopted are all illustrated. In showing you this slide, I may be permitted to say a word in

homage to the memory of the inventor of the vacuum pump bearing his name, Dr. Hermann Phillipp Sprengel, who died in London on the 14th January last, at the age of 72 years. It was by the introduction of his mercury vacuum pump in the year 1865 that the necessary vacuum was obtained for the manufacture of incandescent lamps. In the next slide is shown the department for the testing of lamps for homogeneity and for good vacuum, &c., which is a very important operation if satisfactory results are to be arrived at. In another slide is shown the room for photometer testing and calibrating for candle-power and voltages, a most important operation so far as the users of lamps are concerned.

The next slide shows the arrangements used for capping and for final testing of lamps, the stamping and packing room. You will see from these slides that there are in all about forty-five operations which each lamp has to undergo, all of which are different. Although a great deal of machinery is used and automatic operation has been introduced, there are still a great number of processes in which the skill of the individual operator can show itself, and on which, according to the experience gained by the operator, the manufacture of good or bad lamps depends. After a personal visit to several works I can safely say that the processes used for the manufacture of lamps are more or less the same by the different lamp makers, and I think that very great credit is due to the forethought and ingenuity displayed by pioneers, such as our much respected Sir Joseph Swan, Messrs. Lane Fox, Edison, Maxim, Robertson, &c., who have devised those processes which form the basis for all the newer lamp works.

The Edison-Swan Company have been good enough to lend me a show-case in which the oldest types of lamps are to be seen, leading up to the latest forms, which differ slightly from the original design.

In order to show you the relations which exist between the light given out by a lamp carefully marked for candle-power and the voltage at which it is to work, as well as the relation which exists between the efficiency—*i.e.*, the consumption of watts per candle and the life of the lamp—I will show you a small experiment by taking an Ediswan lamp which is marked 60 volts, and is supposed to give 27 candle-power at that voltage, but on putting this lamp in a circuit with fluctuating voltage, say from 41 volts to 68 volts, you will notice that the lamp will give you only 1·71 candle-power if worked at 41 volts, consuming 20 watts per candle-power, having an extraordinary long life; but it will give you about 48 candle-power if worked at 66·5 volts, and will consume only 2·3 watts per candle, having, however, a very short life. If used at 60 volts, as intended, it will have a useful life of over 800 hours, consuming only 3·1 watts per candle-power. This experiment gives me a good margin for showing you the fluctuations of voltages, as we have at our disposal a 100 volt circuit in the rooms of the Society. For intermediate candle-power see the following Table I, which has been obtained from a test made at the Zürich Polytechnic several years ago :—

TABLE I.

i	Δ P	w	E	H	$E = \frac{E}{H}$
Amp.			Watts.		
0·877	41·41	47·31	36·31	1·76	20·60
0·985	45·18	45·85	44·52	3·60	12·37
1·097	49·01	44·69	53·74	6·55	8·20
1·211	52·79	43·60	63·90	11·07	5·77
1·326	56·72	42·76	75·23	17·85	4·21
1·385	58·60	42·30	81·18	22·38	3·63
1·446	60·59	41·90	87·61	27·61	3·17
1·506	62·48	41·49	94·08	34·13	2·76
1·567	64·46	41·12	101·05	41·16	2·55
1·629	66·32	40·71	108·63	48·35	2·33

TABLE II.

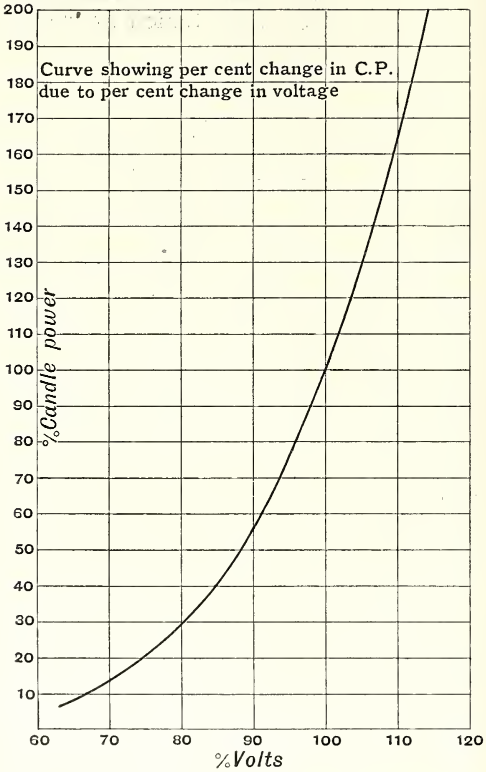
i	Δ P	w	E	H	$E = \frac{E}{H}$
Amp.	V.		Watts.	NK	W
0·4212	77·19	183·3	32·51	2·99	10·87
0·4431	80·89	182·5	35·85	4·13	1·67
0·4668	84·80	181·7	39·58	5·60	7·07
0·4903	88·83	187·2	43·55	7·41	5·88
0·5136	92·87	180·8	47·70	9·71	4·91
0·5360	96·7	180·4	51·84	12·42	4·18
0·5588	100·60	180·0	56·21	15·76	3·57
0·5823	104·58	179·6	60·90	19·70	3·09
0·6057	108·60	179·3	65·78	27·25	2·7
0·6295	112·57	178·8	70·85	29·41	2·71

For the fluctuations of a 100 volt 16 candle-power lamp, I annex Table II., in which it is to be understood that

i = Current, ΔP = voltage.
w = Resistance, E = energy consumed.
H = Light measured in candle-power.
E_1 = Efficiency measured in watts per candle-power.

In order to show you the relation which exists between the percentage change in candle-power, the percentage of voltage and the following curve (Fig. 1) has been prepared by the British Thomson-Houston Company at Rugby, and in order to show you the relation which exists between efficiency and life of lamps, the Robertson Company prepared the curve (Fig. 2), from which you will notice that the higher. the efficiency the shorter the life of the lamp and less will it stand the voltage fluctuations of 8 to 10 per cent. above the normal which take place in some of the supply circuits. Similar curves have been supplied by Ediswan Company, but they arrived too late to be engraved. Through the assistance of Messrs. Everett and Edgcumbe's Portable Watt Photometer, I can show you the watts used per candle-power, the total energy consumed by the lamp, and the light given out by the lamp I am experimenting with to-night.

FIG. 1.



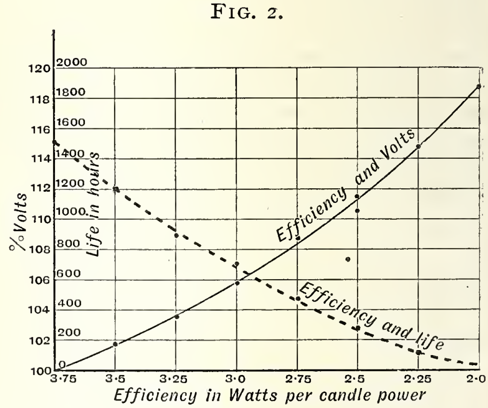
The experiment will explain the reason why unsatisfactory results are obtained in the daily use of incandescent lamps if due care is not taken in using the lamps at the right rated voltages, and if they are exposed to the great fluctuations of voltages of the supply circuits.

The marking of the lamps regarding candle-power and the voltages is very essential for satisfactory working, but it is also essential that the efficiencies at which the lamps are supposed to work should be indicated, because there is a certain period in the life of a lamp when it is economical to replace it by a new one. This point is clearly brought out in an article in the *Electrical World*, of which the following is an abstract:—

"The cost of lighting is very largely dependent on the progressive drop in candle-power which occurs in all types of lamps. Many central station managers consider that a lamp has passed its useful life when it has lost 20 per cent. of its initial candle-power. Poor regulation of candle-power causes rapid deterioration of the lamps. The following Table shows the decrease in life of Standard 3·1 Watt lamps due to increase of normal voltage:—

Per cent of normal voltage.	Life factor.
100	1
101	·808
102	·681
103	·662
104	·452
105	·374
106	·310

FIG. 2.



The author recommends the use of portable volt meters for frequently determining the voltage at different points of the distributing network, and then either arranging the voltage to suit the lamps or *vice versâ*. The following Table gives the variation in candle power and efficiency of standard 3·1 watt lamps due to variation of voltage:—

Per cent. of normal voltage.	Per cent. of normal c.p.	Efficiency in watts p.c.
90	53	4.68
91	57	4·46
92	61	4·26
93	65	4·1
94	$69\frac{1}{2}$	3·92

Per cent. of normal voltage.	Per cent. of normal c.p.	Efficiency in watts p.c.
95	74	3·76
96	79	3·6
97	84	3·45
98	89	5·34
99	94½	3·22
100	100	3·1
101	106	2·99
102	112	2·9
103	118	2·8
104	124½	2·7
105	131½	2·62
106	138½	2·54

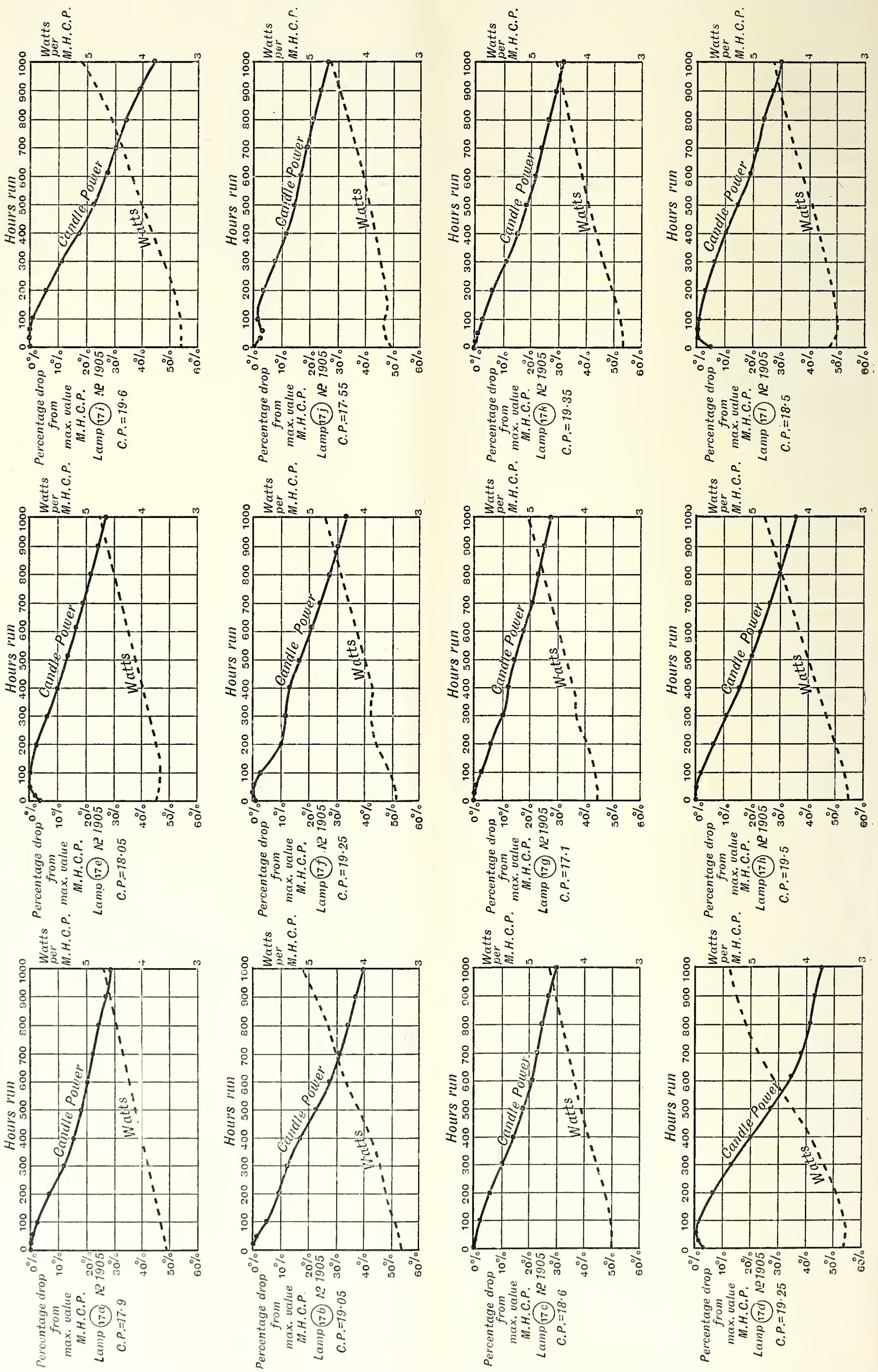
The proper renewal of lamps is a matter of extreme importance from the point of view of economy. The author recommends in this article free lamp renewals and considers this method best for both the central station and the customer. Failing this, the next best plan would be to offer lamps at less than cost price, thus encouraging the consumer to renew his lamps at frequent intervals.

In an article by F. W. Willcox on the quality of incandescent lamps, the folly of using cheap lamps of low grade quality is pointed out. The most rational basis of comparison is to estimate the value of a lamp in terms of the candle hours which it is capable of giving before the candle-power falls to say 80 per cent. of its initial value. A basis of comparison consists in assuming an average life of 600 hours for each type of lamp. On this basis a comparison of four types of lamp shows that the worst type furnished only 66 per cent. of candle hours obtained with the best type, the intermediate ones giving 80 per cent. and 91 per cent. respectively. When the cost of energy is taken into account these results show in a striking manner the disproportion between the small difference of initial cost as compared with the corresponding difference in cost of candle hour. This leads us to the point that it is not a wise policy to buy cheap lamps and thus force the manufacturer to produce bad lamps which fall below the proper standard, and that it is more advisable to pay a few extra pence and get a lamp which is more efficient. The consumer will thereby get a better value for his money, seeing that the bill paid for the light is about the same at the beginning as at the end of the life of the lamp, whereas the light given out is decreasing very fast when using bad lamps.

What is now required for marking the lamps properly is to give a legal value to the standard candle as a primary unit at which the lamps are to be marked. This unit of light unfortunately varies in different countries, but in this country we are particularly badly off, there being no legal meaning attached to the candle, which has long been discarded as impracticable and unreliable. The National Physical Laboratory sees the necessity for establishing a department for photometrical work, the authorities being desirous to establish there a sound basis for that work in Great Britain, so that points of uncertainty and dispute may be cleared up and assistance be given to inventors and manufacturers in perfecting improvements connected with the important subject of illumination. The chaotic state of affairs *re* the settling upon a primary unit standard of light was made abundantly clear in a paper read by Dr. Fleming before the Institution of Electrical Engineers in 1903. It was then generally agreed that a thorough investigation of the subject was needed, and suggestions were made that the National Physical Laboratory should equip a department where accurate photometric work could be undertaken. Such a department has now been organised, and I have pleasure in throwing upon the screen a picture of the room temporarily used for such work. It is also expected that the National Physical Labratory should undertake the calibration of secondary standards for lighting, so that station engineers and others who have to measure the illumination may be sure of reliable and uniform results of their photometric tests. The general equipment of the photometer room has been carried out with a view both of rapid repetition work and convenience of experimental work. I cannot go into the details of describing the equipment, but I think it will interest you to have a general view of the photometer bench, which is of the Reichs Anstalt type and has been presented to the laboratory by the Chairman of to-night, Sir William Preece, whose munificent donation is much appreciated, and it is hoped will be imitated by others who are interested in such kind of work. I am indebted for these slides and particulars to Mr. C. Paterson, of the National Physical Laboratory, and thanks to the kind permission of Dr. Glazebrook, the Director of the National Physical Laboratory, I am in a position to show you a few slides giving some of the results of tests of lamps carried out at the laboratory a short time ago.

You will notice in the first slide twelve diagrams representing the drop in candle-

FIG. 3.



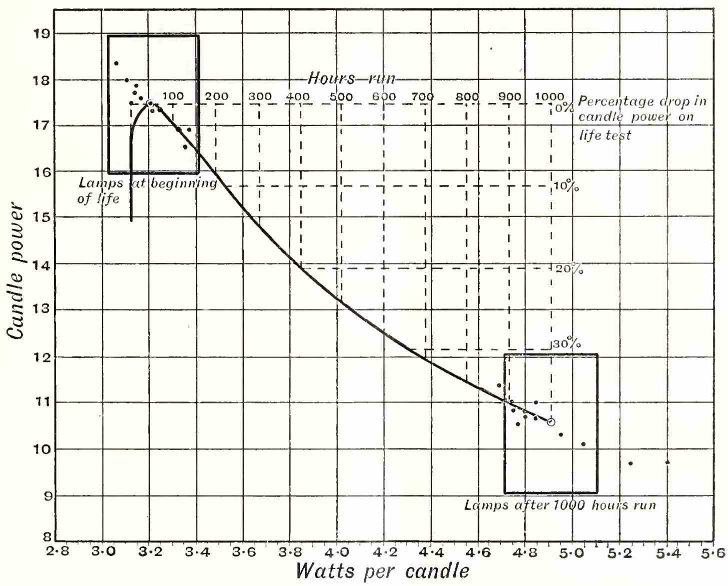
24 GLOW LAMPS (100 volts., 16 candle-power).—Curves showing percentage fall in candle-power on life test.—Nat. Phy. Lab., September, 1905.

power and rise of watts used of twelve lamps made by the same manufacturer. (Fig. 3.) The results obtained from these lamps burning for the same life test and under equal conditions, therefore, ought to have given more uniform results, but they vary considerably. The next diagram (Fig. 4) has been drawn in order to obtain an average of different lamps, made by the same manufacturer. From the other diagrams (Fig. 5, 6) you will notice that the average performance of lamps made by different manufacturers gives still more varied results, some better than others.

public, otherwise the bad lamps are added and the average performance is thereby lowered. Against this addition of poor lamps the consumer must be carefully guarded—if necessary by legislation.

In the proper selection of lamps lies part of the secret how to secure great economies for the consumer. I know that there is now an opportunity for the public to get some standardisation, and I should like for this purpose to draw attention to the valuable work of the existing Engineering Standards Committee. The public would be much benefited by the work of this com-

Fig. 4.



12 Glow Lamps (100 volts., 16 candle-power).—Diagram showing candle-power and watts per candle at beginning and end of life, and curve of percentage drop in candle-power (average) during a life of 1,000 hours.—Nat. Phy. Lab., December, 1904.

Note.—The square represents the following limits. Candle power + $1\frac{1}{2}$ to − $1\frac{1}{2}$ candle, Watts per candle + or − 6 per cent.

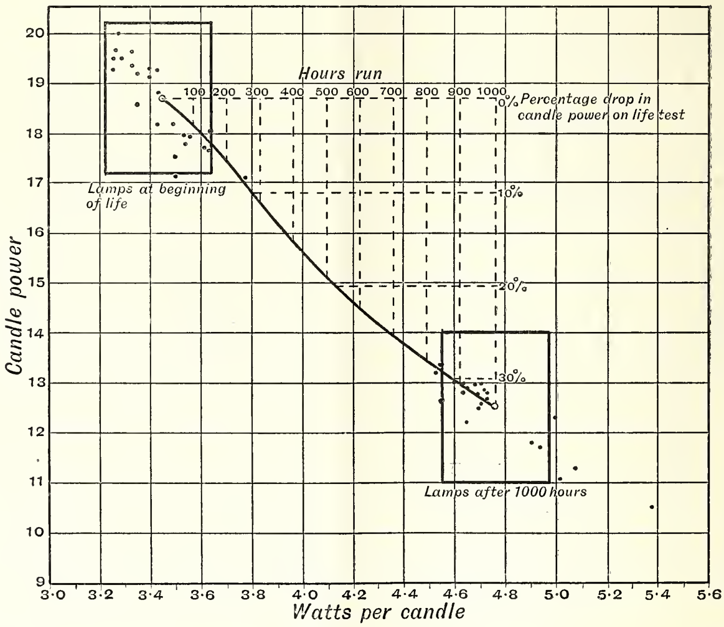
It is not intended from the Tables given before or from these comparisons to draw the conclusion that the performance of the lamps tested represent the best results obtainable, but I have shown them in order to enable you to judge how different makers' lamps give such varied average results. In comparing similar diagrams obtained with higher voltage lamps now on the market, the results obtained are at least 25 per cent. worse than in the case of the lower voltage lamps. In the manufacture of lamps, as pointed out previously, a large percentage has to be thrown aside if the manufacturer is at all anxious to keep to the specification and give satisfaction to the

mittee if they could obtain the adherence of the lamp makers to a standard specification for the carbon filament glow lamps. The time is ripe for this step, and I am given to understand from the interviews I have had with several prominent lamp manufacturers, that they are willing to assist as much as possible in coming to a decision. The fact that all the Government departments will order their lamps by the standard specification will naturally carry an enormous weight throughout the country and the Colonies. There is a great opportunity for the lamp makers, as a body, if only they would realise it, to put their grievances before the Engineering Standards Com-

mittee and ask them to use every effort to bring home to the municipalities and station engineers the invaluable benefits to be gained if only they would keep their pressures more constant. One cannot reasonably expect the manufacturer to guarantee a certain efficiency for his lamps when, as is usually the case, the life test is carried out on a steady pressure, but the lamps are used in ordinary circuits, which in many parts of the kingdom have variations far exceeding the Board of Trade limits. A strict regulation of voltage would go far to reduce the customers' bills by the use of secondary standards for the use of the manufacturers.

A correspondence appeared recently in *The Times* Engineering Supplement of the 8th November *re* "The Standardisation of Electric Lighting" and as by the contents of the article published on the same date the requirements of the public are clearly stated, I may be permitted to reproduce it here. The only addition I would venture to make is that the test of lamps should not be confined to the beginning of their use, and limited to the correct marking of candle-

FIG. 5.



24 GLOW LAMPS.—Diagram showing candle-power and watts per candle at beginning and end of life, and curve of percentage drop in candle-power (average) during a life of 1,000 hours.—Nat. Phy. Lab., 1905.

NOTE.—The squares represent the following units:—Candle-power + $1\frac{1}{2}$ to — $1\frac{1}{2}$ candles, Watts per candle + or — 6 per cent. Large circle shows average position for all lamps.

higher efficiency lamps, and would go a long way to increase the number of consumers of electric light who refrain from its use on account of the high price of current only. I think this point is now under careful consideration by the Standards Committee, and if I have brought this subject up here for discussion I have done so bearing in mind that this Society is in a position through its great influence to contribute in making known the existence of the Standards Committee and to emphasize the desire of the National Physical Laboratory to assist the lamp makers and the public by accurate testing and calibration of power and voltage, though this would in itself be a great advance over the present practice. The testing should be extended to the life of the lamp, and should conform to a standard specification, which I hope will shortly be issued.

"We publish this week a mass of correspondence of an interesting and suggestive nature, referring, as it does, to one of the most important questions which had arisen in the recent history of the electric lighting industry. It is well known that the British market for years past has been a dumping ground for continental glow lamps which, offered for sale at low prices, have been bought largely by an unsuspecting public,

to the consequent detriment and discredit of the general industry. Though there are certain difficulties in the way, there can be no doubt that standardisation would have the effect of preventing, to a large extent, the sale of lamps inferior to their rated efficiency. With regard to the general questions, either an electric lamp is a measure or it is something measured—that is to say, we may suppose the lamp to be sold as an instrument for providing so much candle-power of light from the mains, or, on the other hand, merely as a commodity, which is purchased like a loaf of bread or a yard of silk, except that, instead of weight or size, it is illuminating capacity that determines its selection. Now, in either case there is an obvious need for the imposition of some simple test. If the lamp is to be regarded as a medium for measuring out 16 candle-power from the supply mains, its accuracy should be as unquestionable as that of a surveyor's tape or an imperial pint measure; and, again, if it be considered not a measure in itself, but as a measured commodity, the responsibility of accuracy remains, and it should be as unlawful to trade in lamps marked 16 c.p. which give only 14 c.p. as to sell short pounds of bread or short yards of silk. It may be objected that the testing and stamping of every lamp is impracticable, as well as unnecessary. All that requires standardisation is the means of testing, means, of course, accessible in multiplicate to the manufacturer. Nothing more is then needed than that the purchaser should be able to carry any doubtful lamp to an official testing place if he chooses, and that penalties should be provided to meet any case of dishonest dealing."

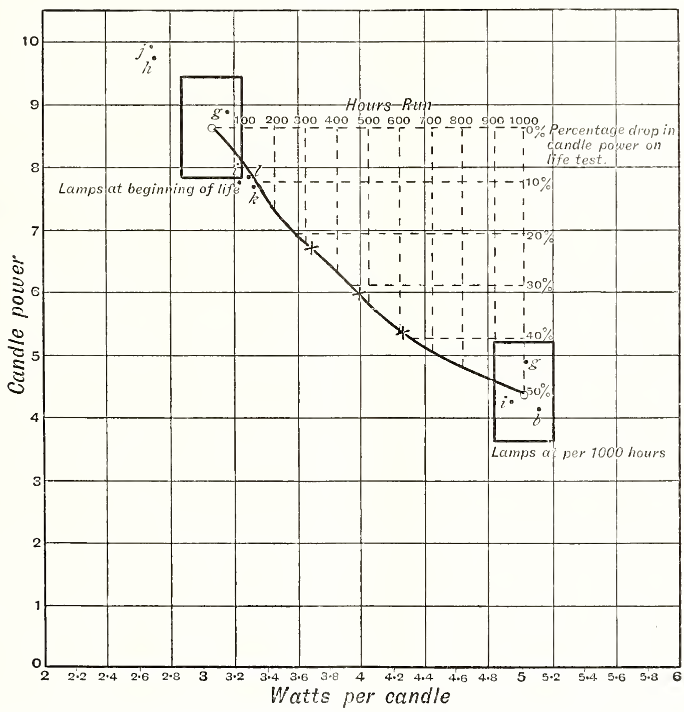
With this view I am in perfect accord.

The next slide shows the new building that the National Physical Laboratory is erecting with a view to carrying on the work of photometry. The progress made in photometry generally has been great during the last few years, attention having been given particularly to reducing the operations getting out results. These also are more accurate than those which used to be obtained by more tedious operations.

But this subject of photometry is too wide to be discussed now, and therefore I think it best to pass it over. There is, however, every hope that the National Physical Laboratory will do their best in equipping the laboratory with the latest type of photometrical measuring apparatus.

It is to be expected that when the Standards

Fig. 6.



6 Glow Lamps (100 volts., 8 candle-power).—Diagram showing candle-power and watts per candle at beginning and end of life, and curves of percentage drop in candle-power (average) during a life of 1,000 hours.—Nat. Phys. Lab., September, 1905.

Note.—The squares represent the following limits:—Candle-power + 0·8 to − 0·8 candle. Large circle shows average position for all lamps. Crosses indicate position at which lamps broke during life test.

Committee specifications are published the consulting engineers, in deference to public opinion, will specify and use them.

If there were any means available for applying the same strict tests to imported lamps, it would be a very great gain to consumer and industry alike by raising the reputation and the value of electric lighting as an efficient system of illumination.

I understand from Sir Joseph Swan and other leading lamp manufacturers in this country, that there is no difficulty now in producing 100-volt lamps consuming only $3\frac{1}{4}$ watts per candle, and having a useful life of 600 hours, without dropping more than 20 per cent. of their initial candle-power. The higher voltage lamps, which are far behind the lower voltage ones in efficiency, could be guaranteed to be made to consume $4\frac{1}{2}$ watts per candle with no bigger drop than 20 per cent. in 600 hours. It is even expected and hoped that the manufacture of high voltage lamps will be shortly improved so as to bring them up to the efficiency of the lower voltage lamps.

The researches made recently with high temperatures obtainable by the aid of the electric furnace promise to assist in improving the manufacture of lamps using carbon filaments. As a first example I will show you to-night two lamps kindly supplied for the paper by the British Thomson Houston Company representing the results obtained by John W. Howell at the works of Harrison of New York. It is claimed for these lamps, which have a graphitised filament, that they have a useful life of about 500 hours without losing more than 20 per cent. of their initial candle-power in this period, and starting with an efficiency of only 2·5 watts per candle. The filaments of these lamps have been exposed to very high temperature in an electric furnace. The specific resistance is thereby considerably reduced. The lamps shown are of 50 candle-power at 100 volts consuming 125 watts. The characteristic feature of these lamps is also the complete equipment, including the reflectors, by the aid of which a proper distribution of light can be obtained. This is one of the instances in which the manufacurer of incandescent lamps has studied the useful application of shades which was neglected in former years, an attempt which is worthy of imitation by the other makers.

This subject of the proper design of shades requires a special study and opens a wide field for further researches, because it is necessary that not only lamps should be studied from the electrical efficiency point of view as far as they are instruments for converting electric energy into light, but they have to be improved upon to become more efficient for illuminating purposes. By a happy selection of lamp, shades, and reflectors, and by a judicious distribution great economies can be obtained. From my personal experience I can state that in many instances by the simple change of the lamps and with the use of proper shades a reduction of about 40 to 50 per cent. off some electric lighting bills has been obtained. There is no doubt that in many places too much light is wasted and could reasonably be saved, and there are on the other hand places in which by getting a stronger candle-power lamp the illumination could be greatly improved. To my mind it appears there is a wide field open for properly trained illuminating engineers.

The thermodynamics of electric incandescent lamps has been lately studied closer, and I would refer you, amongst others, particularly to a paper recently read by Dr. E. F. Roeber before the American Electro-Chemical Society, from which it appears that in converting electric energy into light the theoretical efficiency of the transformation works out at one watt per 8·63 spherical candle-power, which is very far from what we are accustomed to obtain from the lamps. We seem to be satisfied, for the present, to speak of consumption of watts per candle, and when we come down to one watt we consider we have achieved an excellent result. but in the light of what has been said, we ought in time to come to speak of candle per watt and not of watts per candle. This value obtained by Roeber seems to be different from what has been given previously. The methods of separating the visible from the non-visible rays requires a closer investigation. In this direction Professor Dr. W. Wedding has done some good work by examining the relative efficiencies of different illuminants and he has compiled the following Table giving the comparative cost of producing light from several sources now mostly used. In comparing efficiencies it is necessary to measure the mean spherical candle-power given out by the lamps, otherwise the comparison is not strictly done, because according to the form of the filament and the shape of the lamp, and also if reflectors or diffusers are used, the light will be concentrated or diffused, and given out more in a particular direction than may be the case with another lamp; but still it may not

be more efficient as far as the convertion of electrical energy into light is concerned. This measurement of candle-power has been done by the author.

Dr. Wedding, after having gone thoroughly into the merits of the different illuminants, emphasises, as many others have done before, the fact that apart from the light obtained from the different illuminants we have to bear in mind the amount of heat and obnoxious gases which are the results of combustion, vitiating the air to a very large extent, and from this comparison it appears that electric incandescent lighting stands unapproached on its merits on account of the total absence of such obnoxious gases, while the heat given out is insignificant. Apart from the advantage of easy distribution there is also that of instantaneous starting and extinguishing. Among other exhibits I should like to draw attention to those of the "Improved Electric Supplies," Ltd., and the "Reflex" lamp made by the Britannia Electric Lamp Works, Ltd.

Having spoken at considerable length as to the merits and the future of the carbon incandescent filaments, and seeing that there are no immediate prospects of making very great strides in improving the efficiencies, except by regulating the manufacture to standard specifications regarding the marking and behaviour of lamps in the life test, I may be permitted to pass in review some of the new types of lamps which have been brought out during the last six years. I shall start with the oldest of them, the "Nernst Lamp," the merits of this have been fully described in this room by Mr. James Swinburne in a paper read on the 10th of February, 1899. The progress made since then consists mostly in the improved manufacture of the filament, so as to enable the manufacturers to guarantee a bigger average of life, which is now of about 450 hours per burner. But the two drawbacks, viz., the short delay in starting to light up the burner when the lamp is switched on, and the necessity of keeping to the polarity with direct current circuits, has somewhat retarded its extended use, which otherwise would have been greater on account of this lamp burning at a higher efficiency than the carbon filament, consuming from 0·9 to 1·9 watts per candle. The Nernst lamps are now made in different sizes, and you have a dozen lamps burning in one of the chandeliers here consuming 0·5 amperes at 100 volts. The lamps are made in small and large units, giving from 14 to 850 candles, and there are here several of the latest types exhibited on the table, kindly lent for the occasion by the Electrical Company, Limited, who import the lamps. The lamp works more efficiently at higher voltages. There are trials being made to overcome the drawbacks previously mentioned, and I am also given to understand that it is expected shortly to reduce the price of the filament, which consists chiefly of zirconia, with an addition of a little basic oxide of the Ytrria group.

I have to pass on to the next lamp, and that is the "Osmium Lamp," the invention of Dr.

TABLE III.—Table of Comparison between the Efficiencies of different Illuminants, from tests made by Professor W. Wedding. (*See* Elektrotechni Zeitsch, Jan., 1905.)

Nature of Illuminant.	Intensity.		Consumption per hour.	Heat used. Cals. per c.p. per hour.	Cost per c.p.		Litres of CO_2 produced per hour.
	Horiz. c.p.	Spher. c.p.			Per 1,000 hours. Pence.	Per hour. Pfennig.	
Petroleum lamp	14·8	13·2	43·6 gm.	36·4	9·08	0·083	70·1
Alcohol incandescent lamp	65·3	42·9	129 ,,	16·3	10·03	0·088	119
Auer burner	73·8	52·3	112·3 litres.	11	3·17	0·027	59·1
Pressure gas light	303	214	272 ,,	6·48	2·12	0·018	143
Lucas light	581	411	630 ,,	7·82	2·23	0·019	322
Millennium light	1,500	1,060	1,200 ,,	5·77	1·65	0·014	631
Carbon filament lamp {	43·8	34·6	101 watts.	2·6	14·11	0·120	..
	18·3	12·8	59·1 ,,	3·99	21·14	0·184	..
Osmium lamp	42.3	31·4	48·7 ,,	1·34	7·41	0·062	..
Nernst lamp	184·5	113	213	1·63	8·82	0·075	..
Arc lamp	..	400	440	0·95	5·18	0·044	10·7
Flame arc lamp	..	1,880	440	0·2	1·06	0·009	21·4
Breath from one person	..	..	..	..	..	..	14

Auer von Welsbach. In this lamp the filament is made from the rare metal osmium. The lamp burns with a higher electrical efficiency than carbon filaments—viz., 1·5-1·8 watts per candle. The lamps for the present are made of different candle-power, starting from 2½ at 4 volts up to 32 at 70 to 75 volts; but I am given to understand that 100 to 110 volt lamps can also be manufactured, although the manufacture has not as yet advanced enough to place them on the market. But I am able to show you for the first time in this country a 110 volt osmium lamp. From tests made by several experimentors with osmium lamps, it appears that they can burn an average life exceeding 1,000 hours without dropping more than 10 per cent. of their initial candle-power. The normal voltage at which they are made, and mostly sold for the present, is 37 volts, at which voltage they are rated to give 25 candle-power, but lamps can burn in series in groups of 2, 3, 4, or 6 for higher voltages. The one marked drawback of this lamp is that it is still brittle and will not stand easy handling for transport, but researches are being made to remove this defect. Some of the latest types of these lamps are shown here to-night by the General Electric Company. Twenty lamps are fixed in the chandelier, two in series of 50 volts each, and a few are on the table for inspection. There are also shown a few lamps of low voltage and small candle-power.

The next lamp which claims our attention as having made good progress is the "Tantalum Lamp." This lamp has been put in the market by Messrs. Siemens and Halske, of Berlin, only since January, 1905. By the careful work of Dr. von Bolton and Dr. Feuerlein, the present lamp has been devised. It uses as a filament one of the rare metals tantalum instead of carbon. The tantalum lamp burns with better results on continuous current circuits. The useful life of the lamp may be assumed to last between 500 and 600 hours, if worked at an efficiency of 1·5 to 1·7 watt per candle, but if run at a slightly lower efficiency, viz., between 2 and 2·2 watts per candle the useful life could be extended for over 1,000 hours. For the present the lamps are made to burn on voltages from 50 to 110, at which latter voltage they are rated to give 25 candle-power, but I understand that lamps of 50 candle-power at 110 volts are going to be brought into the market shortly.

From information I received lately, the lamps cannot be conveniently used in alternating current circuits, where the frequencies are higher than 25 per second, and recent researches have shown a very great decrease in life if used on frequencies over 100 periods per second. The question of making higher voltage lamps giving the same candle-power, using tantalum filaments, are being carefully studied. The present 110 volt lamp has a filament of 650 millimetres long, 0·05 millimetres diameter, weighing 0·022 grammes, so that with one kilo of tantalum 45,000 lamps can be manufactured. It is rather doubtful whether the diameter can be decreased. The lamps are used also on higher voltages by placing two or three in series. This lamp is also exhibited here to-night, there being in use ten lamps on one of the chandeliers, supplied by Messrs. Krupka and Jacoby. Lamps have also been made of zircon carbon consuming 2·2 watts per candle-power, of which a sample is shown, but the next lamp I want to bring before your notice is also using a rare metal filament, the "Zirconium." This is a lamp which has only been brought out recently, it is Mr. Zerning's invention, and is claimed to be manufactured of pure metal zirconium, obtained from zircon oxide. According to the tests given, as I have had no opportunity of testing it myself, the lamp is supposed to consume only 1·2 watts per candle, at which efficiency is claimed to have an average life of over 500 hours, without decreasing in candle-power more than a small percentage. This lamp is for the present used on low voltage circuits, but I am given to understand that they can be manufactured to burn at 110 volts. Thanks are due to the International Dowsing Electric Heating and Appliances Company, Limited, for enabling me to show you some of the zircon lamps to-night, and I think it is the first time that these lamps have been exhibited in public. The candle-power rated to be given out for these lamps is 30 candle, if working at 37 volts.

The supply of pure zirconium is not limited, being spread all over the world, so that the price of the metal will not fluctuate with the increased demand. The filament is strengthened by the addition of some of the higher melting metals like chromium, wolfram, uranium, &c., but there is still need for careful handling in transport.

I do not think that I can conveniently show you any more of these lamps as time is getting short, and I cannot mention all attempted improvements that have been made. One thing is however certain, that the inventive minds of many engineers are at work to improve

the efficiency of lamps, but, if I may venture to make a suggestion to the inventors, I should say that there is a large field open for a lamp that can be used with the same fittings, retaining the usual methods of wiring and distribution, and which will stand a 10 to a 20 per cent. fluctuation of voltage without easily getting destroyed or losing much from the initial candle-power and efficiency. The life of the lamp is not of supreme importance if the lamp is made cheaply and can easily be replaced. The high initial price of some of the new lamps is sure to decrease with increased demand and perfected methods of manufacture. Carbide filaments of which much was heard a few years ago, are now almost forgotten, but I must mention them as an attempt to improve the efficiency of lamps.

Before passing on from incandescent lamps to arc lamps, I will try to help in dispelling the erroneous idea which seems to prevail in some quarters — viz., that electric light is not as good for the eyes as other illuminants. This assertion has not been proved in actual practice, although it cannot be denied that the light is uncomfortable in cases where it is brought directly on the line of vision, but even then, it only causes dazzling but no sight defect. This view has been kindly given to me by Mr. Brudenell Carter, the well known oculist, whom I have consulted in the matter. There is no necessity for looking directly at the source of light, as with electric light the lamps may be fixed in such positions that they do not interfere with the sight. The spectrum obtained in examining the light given out by incandescent lamps resembles very much that of the sun, and as no one complains of the light given out by the sun, and nobody dreams of looking at it, so there is equally no necessity to look at the electric light, but merely to make use of its beautiful illuminating effects.

Before closing the chapter dealing with incandescent lamps I should like to mention that eight years ago, on the 10th March, 1898, when Mr. Byng brought before the Institution of Electrical Engineers his paper on the manufacture of high voltage lamps, I took the opportunity of expressing my views in the discussion of the paper as to the future progress in lamp manufacture; and I said then, having regard to the law formulated by Professor Dr. H. F. Weber, of Zürich, viz., the interdependence which exists between the radiating power marked B^2 (a variable factor for different materials) temperature and wave length:—"I venture to say that until a complete study has been made of the different values which this radiating power factor, B^2, may assume when different materials are used, we are not entitled to look upon the researches in the direction of improving the filament as finished, and I believe that we may in time to come improve the efficiency of the lamps, either by varying this radiating power, B^2, or the volatilisation temperature, or both, by a good combination, and wise selection of materials for filaments, and by due care in the manufacture." I think that my remarks then made have been amply justified by the different lamps since then invented, a few of which I have had the pleasure of showing you to-night.

If time had permitted and my paper not being already long enough, I would have liked to include in it some points bearing on the general principles of illumination, but I must draw your attention to the neglected study of the influence of reflection and absorption of wall-papers and decorations in illuminating rooms, which subject, I think, is quite worthy of careful consideration.

I am now passing to another type of lamp—viz., the enclosed vapour lamp with continuous ionization. In this type of lamp the vapour is ionized to start the flow of current, which then continues to flow and maintains the vapour conductivity. Typical of this method is the "Cooper Hewitt Lamp," in which the peculiarities of vapour conductivity have been taken advantage of. The elements of the lamps consist of a chamber enclosing electrodes and a gas of vapour between them. In the usual form one, and sometimes all, of the electrodes are of mercury, the intervening gas between the electrodes being usually mercury vapour. The study of the light produced by a lamp of this character developes the fact that the amount of light per watt of the electrical energy consumed varies very much with different current density, there being very well defined values for maximum light efficiency. The colour of the light emitted is dependent upon the gas carrying the current. Considering the spectra of various gases there appears to be no difficulty in creating directly any colour of light desired by means of gases which are available. Practical difficulties, however, stand in the way, difficulties occasioned by chemical reaction against the walls of the containing vessel and also the conductor terminals necessary for

conveying the current to and from the gas. A still greater and more important practical difficulty is that caused by a particular reaction occurring at the negative electrode when in its state of low resistance, viz., physical disintegration of this electrode by the action of the current. For large currents it appears necessary that the negative electrode to be lasting should be of a material which is capable of physically reconstructing itself on being disintegrated by the current. Mercury possesses this quality as an electrode, and fortunately, said Mr. Hewitt in his last paper, from which these notes are taken, mercury vapour gives a light which though apparently deficient when viewed from a colour standpoint, has advantages which are not so immediately apparent but which render it for certain purposes more serviceable than the same light to which are added the colour rays which it lacks.

Some of the practical advantages of the lamp are that it is not trying to the eye, it is soothing to the nerves, and when suitably used it is admirable for obtaining degrees of light and shade, as, for instance, in reading, in mechanical operations, and in constructing works of art; another advantage is its low cost. The lamp could be operated with from 20 volts upwards, which under favourable conditions gives a light enabling one to see as well with a consumption of one watt of electrical energy as by the use of three standard paraffin candles, except when it is used for the purpose of seeing certain colours. Accepting the unpleasant colour as probably unchangeable for the immediate future, there are a large number of subordinate problems regarding the best sort of glass and the best material of which to make electrodes, and many problems of dimensions and arrangements of parts.

It is expected to obtain a life of from 800 to 2,000 hours from such lamps. There is no consumption of the light-giving element, but the vacuum gradually gives way. There are several types made, for general illumination, for skylights in photographic studios, &c.

The absence of red rays in the Cooper-Hewitt lamp and the predominance of the actinic or chemically-acting rays, makes it of great value to all photographic processes. The Cooper-Hewitt lamp operates on direct current circuits only.

My thanks are due to the Westinghouse Electric Company, who have been good enough to exhibit a few types of the Cooper-Hewitt lamps to-night.

The next lamp of the same class is the "Bastian Mercury Lamp." The advantage of this light as mentioned before is its very high efficiency. The Bastian lamp is similar to the other mercury lamps of the arc type, the light being produced between two bodies of mercury, enclosed within a sealed glass tube. The lamp once set in operation continues to work without readjustment. It is difficult to say at present what the limit of life is, but it is claimed to be about 3,000 hours on an average. The colour of the Bastian light can be modified by mixing cadmium or other metals with the mercury, or by using reflectors painted with rhodamine. The fluorescent rhodamine reflectors add red rays to the light, whereas the ordinary red shade or reflector has not such an effect.

The Bastian light is rich in green and blue rays. The important question of efficiency of the lamp, that is the watts consumed and the candle-power produced, is extremely difficult to determine.

Messrs. Rumney and Rumney, as the representatives of the Bastian Company, are showing some of the lamps manufactured by the company and exhibited here to-night, viz., a street-lantern type, a table standard, a daylight pendant, an office pendant, and one of the workshop type, hand tilted. One lamp has been left here with the mechanism and burner open, so that you may inspect it in actual operation.

The next type of lamp to consider is the "Vacuum Lamp," with intermittent ionization (Macfarlane and Moore). In this type of lamp a permanent gas under reduced pressure is transiently ionized by the high potential stress, thereby becomes a luminous conductor and allows a discharge which relieves the stress, whereupon the ionization ceases, and is re-established with such rapidity that the eye does not observe the interval. The first lamps of this type, according to H. Noel Potter's description, were the Geissler tubes, but the modern representative of this type is the Moore lamp, of which a sample is shown, being lent by Mr. Rosenberg.

Having finished with the incandescent lamps, I am passing now to the arc lamps; but in view of the admirable and most instructive Cantor Lectures delivered by Professor Silvanus Thompson in the year 1897, I propose to deal only with the progress made since then, and to pass in review a few of the principal improvements made, as it is impossible in this paper to give you a detailed description

of all the improvements. Some of the lamp makers have been good enough to send here samples of their arc lamps which you can inspect at the end of the meeting. Great improvements have been made in the manufacture of the carbon electrodes, and also our knowledge has been increased of the theory of the arcs—due to several investigations, amongst them, I may mention prominently, those of Mrs. Ayrton and of Messrs. Blondel, Duddell, &c. The Witton Carbon Works of the General Electric Company, have now improved their manufactures so as to make them equal with the better class of carbons made abroad. From tests carried out at the National Physical Laboratory with some of the carbons, there is hardly any difference to be traced between the English and foreign make. British-made flame carbons have, however, not as yet been put into the market, but I understand that progress is also being made in this direction at the Witton Works.

Various improvements have, however, been made in the construction of the arc lamp. Among these may be mentioned the appearance of the enclosed arc, enabling lamps of a lower candle-power and longer life to be made than was possible with the older forms with exposed carbons. This sort of lamp has come into extensive use and must be considered as a real improvement. The tendency of all the lamp makers has been to lengthen the hours of burning without recarbonising, and adaptation of the single lamp, to burn on circuits up to 230 volts. The ordinary direct current enclosed lamp takes about 80 volts and 4-5 amperes, giving about 300-400 M.S.C.P. For the enclosed arc lamp are claimed a better light distribution, steadiness, and maintenance economy, compared with the open arc.

The General Electric Company of New York, and other lamp manufacturers, in order to improve the distribution of light, have introduced the use of light diffusers which assist in making the illumination more even. The earlier types of enclosed arc lamps were usually made with two globes, but some makers are now using only one with great success. The lamps can burn either in parallel or in series, singly at 100-120 volts, two in series at 200-250 volts, or any number in series on high voltages. The special features are, that they can, as a rule, stand an over load of 80-100 per cent., they can burn exceedingly long hours, even over 100, and they are easily trimmed, running at efficiencies varying from 1-1½ watts per candle.

As a few typical models, I show you first an enclosed arc lamp made by Messrs. J. Defries and Sons Ltd. This is a continuous current lamp, working without external resistance, and it is claimed to give 35 per cent. gain of illumination, or a 25 per cent. saving of current. This lamp can work on 100-120 circuit, consuming 3¾-4½ amperes, the economy in current, it is claimed, lies in the fact that a much higher proportion of electric motive force is utilised in the arc. The volts across the arc are as high as 107 on a circuit of 120 volts on the mains, whereas in ordinary enclosed arc lamps only 85 volts are used across the arc. Another model is the lamp manufactured by the Reason Manufacturing Company (the Lewis) which operate in any number in series without the use of shunt coils. Such lamps have an increased efficiency with a large reduction in the number of working parts, which is a further advance in the manufacture of arc lamps.

There are also some lamps exhibited by the Brockie Pell Co. Ltd., and the latest British Thomson-Houston's new alternating current enclosed type lamp, a very neat design working at 250 volts.

The next step was to make small arc lamps called "Midgets," &c., taking only about 1½ to 2½ amperes, and you will see a sample on the table working at an efficiency of about 1 to 1½ watts per candle, sent by the Union Company and by the Reason Manufacturing Company, Ltd. This variety of arc lamp has been introduced with some considerable success for indoor illumination, and in factories, &c. The greatest progress in arc lighting is to be recorded in the manufacture of "flame arc lamps," in which are claimed increased efficiency of the arc by the use of a mixture of various substances with the carbon, such as calcium, strontium, barium, boron, &c., or other metallic salts, thus enabling a much longer and more illuminating arc to be maintained. The position of the carbon is altered in this construction of flame lamp; instead of their being superposed they are fixed in the lamp, forming an angle with each other, and the arc which is formed between the two carbons fills up the globe with an intense illumination, so that the carbon tips, which are brought to incandescence, throw the light downwards without any shadows underneath the lamp. It has been possible by the increased illumination obtained to get a very great

economy compared with other systems of arc lighting. The size of the carbons used in these lamps is very much smaller than those used in the ordinary arc lamps for the same current, and therefore the consumption of carbons is accordingly very much increased. But in order to produce a lamp of long burning hours automatic magazines had to be provided by some of the lamp makers, or other means had to be devised to reduce the rate of consumption.

You see exhibited to-night some flame arc lamps, manufactured by the Union Electric Company, called the "Excello" lamp, also lamps of the Bremer type, of the Westing-house Company. The "Oriflame" is a lamp manufactured by Messrs. Oliver & Co., which has two magazines, one for positive and the other for negative carbons. Another lamp shown is manufactured by the Armorduct Manufacturing Company, called "The Blaze."

The carbons are arranged in the upper part of the lamp inclining towards each other in the form of a V, so that the arc takes place horizontally between the lower ends of the two carbons. The "Oriflame" arc lamp burns from 40-50 hours, and the carbon ends are automatically discharged one after the other as they are consumed. This flame type of lamp is now manufactured by nearly all the manufacturers of lamps.

Much attention has been paid by the manufacturer also to the question of obtaining a more steady burning of such lamps compared with what used to be the case in their early days. The vapours given out by these lamps, owing to the nature of the salts used in the carbon cores, have to be kept away from the mechanism and, therefore, specially designed lamps have to be used. The value of impregnating carbon has been known for a long time, and I personally conducted experiments to prove the advantages of such impregnation many years ago; the results obtained from tests made, were mentioned by Professor Silvanus Thompson, at the meeting of the Institution of Electrical Engineers, in March, 1898. But only recently those carbons have been put to practical use. The candle-power given out by these lamps is somewhat difficult to measure, but it is estimated that for a ten ampere lamp using on an average 44 volts, about 1,800 candle-power can be obtained, which brings the efficiency down to about 0·25 watt per candle. This is a very great improvement upon the performance of other arc lamps. These lamps are not as yet made for smaller candle-power, but they have found a ready application for street illumination, having also the great advantage of possessing good penetration of fogs.

Although the efficiency of the flame arc lamp is very high, it has been found impossible, so far, to make enclosed flame arc lamps of any description owing to the smoke and gases given off by the chemicals used in the treated carbons. Apart from the use of carbons impregnated with metal salts, there is to be recorded a new direction of research by the use of other electrodes than carbon, viz., "Magnotite," as used by Steinmetz in the lamps manufactured by the General Electric Company of New York. The characteristic feature of the lamp is the use of black oxide of iron mixed with chemicals calculated to increase its life, for the negative electrode, and copper for the positive. The efficiency of the lamp is claimed to be about twice that of the carbon arc, and lamps have been constructed which will burn from 500 to 600 hours per 8 inch long electrodes. It has been found by experiment that the magnetite electrode burns at the rate of one-eighth of an inch per hour, the copper pole being unaffected. In the magnetite lamp the positive electrode is of a copper segment which is of such size that it does not get too hot, and therefore does not wear away, forming permanent part of the lamp. Other substances, such as the titanium compounds, are added to the magnetite, and these reduce the rate of burning.

According to W. E. Holmes, who has had about thirty of these lamps on trial in the United States, the lamps take 4 amperes at 80 volts. During the burning, a fine smoke is given off, which is conveyed away by the chimney. The lamp, like most of the other flame lamps, is therefore not suited at present for internal work. Around the base of the chimney a nickel reflector is used inside the globes, and this adds about 10 per cent. to the general efficiency of the lamp.

The merits of electric lighting for house and street purposes has been of late very seriously considered by gas and electric light engineers, and although very much has been written for and against the merits of the individual systems of illumination, there appears to be still a wide difference of opinion as to what to choose as best. The recent decision of the City authorities to replace some of the obsolete types of electric arc lamps used, by the

high-pressure gas system, has caused a stir among the electrical engineers and arc lamp manufacturers, which stir has, however, been beneficial in bringing out very prominently before the public the superior claims of the improved modern electric lighting systems, which had to be taken more seriously into consideration before departing from the use of electric arc lamps for street lighting. The experiment which is now going on may be considered as a blessing in disguise, because it has made electrical engineers consider the whole question of street illumination more seriously than they did before.

Personally, I think that the progress made in one system of illumination ought to act as a stimulant to its opponent, as there is quite a wide field open for improvement in both directions, A fair and healthy competition is much to be encouraged as, to my mind, it acts very beneficially in the long run.

The question of street illumination is a very wide one, and several papers have been read recently dealing with this subject. There are no hard and fast rules to be laid down for street lighting generally, because what is suitable for one place is not easily applicable to another. Each case has to be studied on its merits.

Having now finished with the subject of progress in electric lighting, I would like to point out that although the necessary amount of light for different purposes varies very considerably, and there are difficulties in the way of framing suitable legislation dealing with the minimum amount of light necessary for seeing. The question of artificial illumination in schools, public buildings factories, &c., where the sight is greatly affected by indifferent illumination, is worthy of a closer investigation, for it affects the health of the nation.

People are, as a rule profoundly anxious to obtain pure air, water, and other commodities necessary for health, but they do not give sufficient attention to the amount of light necessary for the sight, neglecting thereby this most delicate instrument of ours, the eye, which although by nature it is made to accommodate itself to our requirements, yet if put to considerable strain it deeply affects and weakens the sight.

To sum up, I will say that what is still wanted to make electric lighting more efficient is (1) the establishment of a legally recognised primary unit standard of light; (2) the establishment at the National Physical Laboratory of a properly equipped photometrical department capable of undertaking the calibration of secondary standards for the use of manufacturers; (3) the framing of standard specifications for carbon filament lamps; (4) a complete study for the exact measurement of temperature of incandescent filaments; (5) the recommendation to manufacturers of a simple but efficient system of photometry; and (6) an exhaustive study to be made on the principles governing the conversion of electric energy into light.

The subject I have brought before your notice has been a big one, and I feel that I could not do justice to all the different makers of incandescent or arc lamps, or deal with every aspect of the subject; and I beg therefore to tender my apologies if I have not paid enough attention to any or all of them present. Perhaps those who will read the paper will be kind enough to forgive me for the errors made, and will send me any corrections they think essential to be brought before my notice, so that I may embody them in a book on "Arc and Glow Lamps" which I am engaged in writing.

Before closing, I must express my thanks again to one and all who have been good enough to give me the necessary information for writing this paper, and who have assisted me this evening in bringing before you the different manufactures, and in demonstrating to you their relative merits; but I should like to mention particularly the names of Sir J. W. Swan, Messrs. H. Hirst, J. Howell, Gillingham, J. Eck, Robertson, C. Lill, Oliver, Fairbrother, Brown, C. W. Broom, D. Huntley, Dowsing, and others.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said the author had read an admirable paper which he was sure would receive the careful study it deserved. But, apart from the paper, Mr. Gaster had brought together with great energy and determination an exhibition of electric lighting which, in interest and novelty, exceeded not only anything seen in the rooms of the Society, but even equalled, on a small scale, the display given at Olympia not very long ago. Those who unfortunately had to find their way to railway stations in the dark had the opportunities of seeing for themselves exhibitions of lighting in the streets; and there were many people like the omnibus driver the author mentioned who, when they saw the new beautiful flaming lamps in the streets of London, imagined they were gas lamps. The author had run very rapidly through an extremely interesting history of the development of electric lighting, and in doing so had omitted to

refer to one or two points. The lighting capacities of the incandescent and arc lamps had improved very much; but there was a good prospect of the cost of electric energy diminishing in a larger ratio. Hitherto consumers of electrical current had been in the habit of paying 4d., 5d., and 6d. a unit, but the time was rapidly approaching when the pennies would be reduced to halfpennies, and their poor gas friends, who were struggling very hard indeed at the present time to obtain dividends on their capital, would find a greater difficulty than ever, and probably the time would come sooner or later when even they would have to consider the generation of electrical energy. The author had referred at some length to the efficiency of the lamps, and he wished that everybody would thoroughly understand what that really meant. It would take a long time to define the efficiency of a lamp, but the economy of domestic lighting was dependent on the efficiency of the lamps. Mr. Gaster had shown how the 4 watts per candle had come down in the carbon lamp to 3 watts per candle, and for show purposes to 2 watts per candle. The new Nernst lamp was somewhere under two watts per candle, and the Tantalum, a most promising light, took, for an ordinary average light, about two watts per candle, but that had even come down as low as 1·5. What with Osmium, Tantalum, Zirconium and Zircon-Carbon lamps, it was quite certain that before very long, a great reduction would take place in the price of lamps. Perhaps one of the most interesting was the Cooper-Hewitt development of the mercurial vapour lamp; and the practical domestic lamp, introduced by Mr. Bastian, was certainly, from his own experience, a delightful lamp. He had, in his office at Westminster, a large office lighted by a central electrolier, with five or six lamps, but in the bay window he had a Bastian mercurial vapour lamp, the advantage of which was that while the ordinary glow lamp gave a rather dull yellowish series of rays, the mercurial vapour lamp gave green and blue tints. The effect of the Bastian lamp supplementing the glow lamps was to give on his desk in his room absolute daylight, and it had over and over again occurred that the transition from daylight to artificial light had passed without his noticing the difference. A similar advancement had been made in arc lamps. The enclosed arc lamp, the Brockie-Pell lamp, the Jandus, and the flaming lamps were as great advancements on the old type of arc lamp as the new incandescent were on the old incandescent lamps. The members of the public were learning more and more of the principles of artificial light, and when they became instilled with the doctrine of the efficiency of the watts per candle, they would then find their purses would benefit to a very large extent by the economies introduced.

Dr. R. T. Glazebrook, F.R.S., welcomed the opportunity which had been afforded him of supplementing to a slight extent some of the points that had been emphasised, and of expressing on his own behalf the great indebtedness which the audience felt to the author for the trouble he had taken in preparing his paper, together with the admirable collection of lamps which had been exhibited. The importance of the subject was undoubted. He believed it was in the author's own article in *The Times*, or, at any rate, about that period, that some figures were given, which might usefully have been quoted in the paper, showing the proportion of electrical energy generated that was utilised in the production of light. The figures then given indicated the vast sum which was spent for light, and the saving that would be caused by improving the efficiency or quality of a lamp by even a few points per cent. Mr. Gaster had done well in calling attention to the great importance of the makers improving the efficiency of the lamps, so that the public would be able to obtain the higher efficiencies which the makers could and would give by adopting some form of standard specification. As some part of his work for the past few months had been concerned with the endeavour to prepare such a specification, which it was hoped would be placed before the public shortly, he was glad to take the present opportunity of thanking all the makers, who had so willingly co-operated in preparing it, for the help they had rendered, without which it would not have been possible to make the advance which had been made. Turning to the means which were to be adopted for standardising the light and giving makers, contractors, and others concerned definite standards of light, the author had already explained that there was no real standard of light in the country. The gas companies had all adopted the standard of the London gas referees, the 10 candle-power Pentane lamp, which, for use in a laboratory, with proper restrictions and care, was a most admirable standard; but it was not one which either those who had used it or he himself would recommend as a standard for ordinary use in a lamp factory or in a testing station. One of the pieces of work which he was at present endeavouring to carry out was to establish, on a satisfactory basis, some means of readily and rapidly comparing the secondary standards that the manufacturers and the public lamp-testing stations would use as their standards for testing the lamps, provided the standard specification was agreed to. It was for that reason that a large portion of the building, a photograph of which had been thrown on the screen, had been constructed. A large space, about 100 feet by 25 feet, in two storeys, was now being fitted with all the appliances necessary for the rapid and accurate photometring of electric lamps, comparing them with the fundamental 10 candle-power Pentane standard which they hoped to have. In order to enable comparisons to be made between the standards of light in this country and elsewhere, a very considerable series of comparisons between the English

Pentane standard, the German Heffner standard, and the French Carcel standard had been going on in his laboratory for some time past, the results of which he hoped would be shortly published; so that it would be possible to know with a greater approach to accuracy than was the case at present what a 10 candle-power German or French lamp was, expressed in English units. The National Physical Laboratory had, moreover, been co-operating with the authorities in America to secure uniformity of standard between England and America, and from all those with whom they had co-operated very great assistance had been received, which he trusted would render their labours of more value to the public when they were completed, and the results published.

Mr. JAMES N. SHOOLBRED said that when the Chairman wrote his valuable paper on electric lighting in 1881, there were two important installations going on, where incandescent lamps were largely in use, the Forth Bridge Works and Tate's Sugar Works, at Silvertown. Swan 16 candle-power lamps at 110 volts were used in both places, and this combination had a very large bearing on the question of electric lighting in England, since it practically settled the standard pressure in most of the towns which subsequently adopted the electric light. Likewise the 110 volts happened to allow of two arc lamps being run in series, a combination known as the "pair-series" for arc lamps. A large series of records of the history of the lamps was taken at Silvertown, and it was a surprise to him to remember how well the lamps behaved in those early days, and to note what comparatively small progress had apparently been made in their development in the last 25 years. No doubt great improvements had recently been made, especially in arc lamps, and probably the industry was on the verge of still further developments. Dr. Glazebrook's remarks as to the standard of light were exceedingly interesting, and he would like to refer that gentleman to a discussion which took place at the Electrical Congress held at Paris in 1881, at which some most valuable information was given on that point.

Mr. GASTER, in reply, thanked the speakers for the very kind way in which they had alluded to his paper, and particularly Dr. Glazebrook for the assistance he had given him in supplying him with the results of the tests. He desired that the paper should be impartial, and therefore had not embodied any figures of his own, because they might be wrongly construed; but as the figures were supplied by the National Physical Laboratory, they were, of course, entirely unbiased, and therefore of the greater value. He wished particularly to thank the Chairman for the kind manner in which he had supported him.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Gaster for his interesting paper, and the meeting terminated.

COST OF LIVING IN AUSTRALIA.*

It has frequently been asked whether the cost of living in the Commonwealth is higher than in Great Britain. In reply it may be stated that few countries approach Australia in the small proportion of income absorbed in providing food for the people; an assertion fully supported by statistical facts. According to Mulhall, the cost of living, per inhabitant, in the leading European countries, Canada, and the United States, ranges from £32 16s. 2d. in the latter country, to £11 5s. 6d. in Portugal; the amount for the United Kingdom being £29 14s. 9d.; Canada, £23 2s. 2d.; France, £23 19s. 4d.; and Germany, £20 3s. 4d.; while in the Commonwealth it is £42 19s. 10d., or £10 3s. 8d. more than in the United States; but, at the same time, the money is more readily earned in Australia than in any of the countries mentioned. If the sparsely-settled districts were omitted, the amount would be considerably decreased, as the cost of transport would not be included. Again, taking Mulhall as an authority, it would appear that while the actual cost per head of food (solid and liquid) in Australia is £20 7s., as against £14 4s. 9d. in the United Kingdom, the earnings required to pay for the food are proportionately less than in many countries; thus, while in the United Kingdom it takes the earnings of 127 days to pay for the annual food supply per head; in France, 132 days; in Germany, 148 days; in Austria, 152 days; in Italy, 153 days; and in Portugal, 177 days; in Australia, 133 days suffice. In Canada and the United States the period is less, but there are circumstances which turn the scales in favour of the mother country of the Australias. The prices of commodities have varied according to the seasons and other conditions, but in 1904 the average rates were:—Bread, 2lb. loaf, 2¾d.; fresh beef, per lb., 5d.; butter, per lb., 10½d.; cheese, per lb., 8d.; sugar, per lb., 2½d.; tea, per lb., 1s. 3d.; potatoes, per cwt., 4s.; maize, per bushel, 2s. 7d. Mutton is the cheapest animal food, averaging about 2½d. per lb. Other average rates comprise—bacon, per lb., 8d.; eggs, per dozen, 1s.; rice, per lb., 2½d.; oatmeal, per lb., 2½d.; coffee, per lb., 1s. 6d.; salt, per lb., ½d.; colonial beer, per gallon, 2s.; soap, per lb., 4d.; starch, per lb., 5d.; colonial tobacco, per lb., 4s.; imported tobacco, per lb., 6s. Of course, many of the articles named can be purchased considerably cheaper at times, but the average prices will afford some idea of the general cost. Practically, the charges in many instances are the same as in the United Kingdom; in others, beef and mutton, for instance, they are lower. Fruit during the season is considerably cheaper, but vegetables generally are somewhat dearer, market gardening being an industry which has yet to be conducted on business-like principles. Of the total cost, in 1903, of food and beverages, viz., £79 716,000, the expenditure on fresh meat was the largest item, being 25 per cent. of the whole; bread, 9·23 per cent.; milk,

* Communicated by John Plummer, M.I.J., Sydney, New South Wales.

butter, and cheese, 15·18 per cent.; vegetables and fruits, 10·98 per cent.; sugar, 4·76 per cent.; tea, coffee, cocoa, 20·51 per cent.; and wines, beer, and other spirituous liquours, 17·83 per cent. House rent, especially in the larger township, absorbs a considerable proportion of the worker's income, amounting, as a rule, to from 20 to 25 per cent., the weekly rent of labourers' dwellings in Sydney, for instance, generally being—three rooms, from 8s. to 9s.; four rooms, 10s.; and five rooms, 12s. Within the last few years, rents have become lower in some districts. Strangely enough, the utilisation of the co-operative principle for acquiring cottage properties has remained largely neglected by the great body of workers, a result of the migratory character of the industrial population. Practically, a skilled labourer in Australia can, if he so please, live almost as cheaply as in the United Kingdom, with a less amount of work. Nor should it be forgotten that the generally dry and sunny character of the climate prevents considerable wear and tear in clothing. A pair of men's boots are said to last nine months in the Commonwealth, against five months in the United Kingdom. Again, less coal is required for domestic purposes; while the generally clear atmosphere and the absence of soot, even in the big cities, makes the washing day less frequently necessary than in the Mother Country.

MOTOR BOATS IN MANCHURIA.

The American Consul at Niuchwang, in a report to his Government on the use of motor boats in Manchuria, says that the current of the Liao River ranges from 3·4 to 7·8 nautical miles per hour in swiftness, according to the season and the state of the tide. Motor boats will, it is believed, prove useful on it, and a number will possibly be purchased during the present year. The river is subject to a heavy tidal rise and fall, and this causes a strong inward and outward current. About the end of November or beginning of December the river closes, and becomes free of ice, as a rule, in March, and during this interval of approximately three months motor boats may be housed. The foreign population of Niuchwang being about 300, not including the Japanese, the demand for motor-driven boats is not likely to be of any great extent, though motors for converting sailing and rowing boats into power boats may, in the Consul's opinion, ultimately find an extensive market among the native population. Port Arthur, Dalny, Harbin, and other points are, it is said, suited to motor boat service; but at the present time the limited foreign population and unsettled conditions generally do not warrant expectations of important trade advances in this line, although the subject of the ultimate utility of the motor boat, both for purposes of pleasure and recreation as well as for passenger carrying and trade uses generally, has been much discussed at Niuchwang.

HOME INDUSTRIES.

Coal Exports in 1905.—The revival of the iron and steel industry, and the gradual expansion of foreign business which followed the close of the war between Russia and Japan, have greatly improved the position of the coal trade, and if the threatened strike comes to pass in the United States prices are likely to be good for many months to come. The total exports of coal in 1905 amounted to 47,476,707 tons as against 46,255,547 tons in 1904, an increase of 1,221,160 tons upon the exports of that year, which exceeded those of any previous year. It is noticeable, however, that the exports of the South Wales district show a decrease of 745,443 tons, due entirely to the immense diminution in the shipments to Russia and the Far East consequent upon the close of the war. On the other hand the exports of South Wales coal to France show an increase of 84,800 tons, notwithstanding that the total exports of coal from the United Kingdom to France decreased by 20,721 tons. The explanation given by some experts of this falling off in the total export to France is that the coal tax has operated as a bounty in favour of Westphalian coal sufficient to enable it to divert a portion of the supplies hitherto received from this country. However that may be, it appears that whilst the South Wales district showed a decrease in the first six months of 1905 in its exports to France of 124,064 tons, this was wiped out in the second half of the year and converted into an increase of 84,800 tons for the year. The more distant markets continue to show a stationary or declining demand. This diminution is due to the competition of foreign coal, and the consequent loss is not likely to be recovered. Apart from Admiralty and mail requirements, British coal cannot compete with Japanese, Indian, Australian, and American coal in the Far East. It can no longer compete with Japan in China, Hong Kong, Singapore; with India in India itself, Ceylon, Aden, Singapore, and Mauritius; with Australia and the United States in Central America and the West Indies. It is in the European and Mediterranean markets, and that of the East Coast of South America, that the increased demand for British coal has been continuous and great.

Freights and Coast Exports.—Freights were a good deal higher last year than in 1904, but were still strikingly less as compared with thirty years ago. Take, for example, the mean freight from Cardiff to Port Said, a distance of 3,072 miles, which was 6s. 4d. per ton, or only a few pence more per ton than the cost of transport from, say, the centre of the Rhondda Valley to London, 170 miles, to Liverpool, 175 miles, or Southampton, 128 miles. The mean freight to Genoa was 6s. 6d. per ton, to Marseilles 7·75 frs., to Cronstadt 5s. 10d., to Naples 6s. 3d., to Buenos Ayres 9s. 4d. Contrast these times with those of thirty years ago, then the average freight from Cardiff to Port Said was 19s. 6d., to Genoa 17s. 3d., to Marseilles 19 frs., to Cronstadt

9s. 6d., to Buenos Ayres 33s. A consequence of these low freights is that the cost of British coal to the foreign consumer is often no greater than to the British home trader. The foreign, transatlantic, and other passenger steamers and railways can in many places get their supply of fuel as cheap, if not cheaper, than British liners or railways.

The Motor Omnibus Industry.—The recent growth of the number of motor omnibuses plying in London is striking, and even more so the prospective expansion of this kind of road conveyance. A year ago a motor omnibus running down the Strand was a curiosity, to-day it is almost as common as the horse vehicle. Already there are some 170 motor omnibuses on the London streets, not reckoning the reserve, and before the summer is over this number will be doubled. A single company expects to own 200 before the end of the year, and another is said to have 300 cars on order. The difficulty is with the builders, who are months behind time owing to the great demand. It is satisfactory to know that many of the new vehicles will be of English make. It was not creditable to home enterprise that the companies should have to rely entirely, or even largely, upon the foreigner. The greatest present objection to the motor omnibus is the liability to skid in certain conditions of the roads, and the remedy has still to be found. Careful driving, and the proper manipulation of the brakes lessen, without entirely removing, the danger. It is noteworthy that some of the local authorities are now opposing tramway schemes. being in doubt as to the extent of the development of the motor omnibus traffic. The great number of motor omnibuses that will soon be upon the roads will necessitate extending the service far into outer London, and this should be a boon to districts at present ill served by the public carriage, or not served at all.

Fruit Growers and Railway Companies.—It may be expected that the movement on foot amongst producers and distributors of perishable goods, such as green fruits, farm produce, &c., to induce Parliament to put pressure upon the railway companies to amend their regulations in the direction of greater facilities and more liberal treatment will receive a considerable measure of support. It is complained that the classification is out of date, that rates are increased, and facilities withdrawn, in a way not intended by the Legislature, and that the tribunal whose special duty it is to deal with disputes between the railway companies and their customers should be differently constituted. As to classification, probably the complaint generally is not so much as to it as to rates, which, it is contended, ought to be reduced. For example, with regard to the owner's risk rate. Fruit growers say that until quite recently, when fruit was seriously damaged or lost growers were paid for it, but now companies decline to pay anything if the goods are consigned under the owner's risk. It is admitted that there are endless difficuties in settling claims under the owner's risk rate, and many growers would prefer the one rate, that is the company's risk rate. It is a very difficult question whether fruit should be charged at owner's or company's risk, and with regard to the whole question of rates the companies have of course much to say in contravention of the complaints of the growers. Thus whilst it is true that the French railway companies carry at much lower rates the companies here would say that must be attributed in some degree to the fact that the railways in France are State-aided. However that may be, when the Acts regulating rates in England were passed there were only certain small acreages of fruit grown in this country. To-day there is a large area under fruit and much more would be planted if distribution could be made more satisfactory. The extension of fruit growing is greatly to be desired on many grounds, and not least from the point of view of labour.

Merchant Shipping Regulations.—It is authoritatively stated that the Government will bring in a Merchant Shipping Bill in the course of the coming session, and that its provisions will generally follow the recommendations of the Board of Trade Committee presided over by Sir F. Jeune, and which reported in May, 1903, and those of the Select Committee on Foreign Ships, presided over by Mr. Bonar Law, and which reported in July of last year. The first-named Committee dealt rather with the *personnel* of the merchant service, and most of its recommendations do not require legislation to enable them to be carried into effect. The Committee of 1905 dealt with (1) overloading and unseaworthiness; (2) foreign ships trading to ports of the United Kingdom, and the comparative limitation of liability attaching to them as compared with British ships. Foreign ships which have taken any cargo on board at a port in the United Kingdom and are overloaded may be detained, but there is no other penalty provided, there is no requirement as to marking, and no restriction as to the loading on inward voyages. It is now proposed that power be given to the Government to apply by Order in Council in the ports of the United Kingdom the British rule as to loadline to the merchant ships of any country which do not comply with rules as to loading similar to those in respect to British ships. It is also intended to bring foreign ships trading to British ports, and in unseaworthy condition, under the provisions of the Merchant Shipping Act, 1894, so far as they touch this point, and the method of loading grain. Where a cargo of grain is loaded on board any British ship all necessary and reasonable precautions must be taken to prevent the grain from shifting. This requirement does not at present apply to foreign vessels, although the regulations as to another kind of cargo, namely, timber, do. Finally, as to life-saving appliances, it is proposed to empower the Government to apply by Order in Council the rules as to the provision of life-

saving appliances which apply to British ships to foreigners.

British Railway Stock.—A good deal has been said recently about the relative merits of foreign as against British railway stock, and it is not contested that, until recently, the United Kingdom lagged so far as electric stock is concerned. But there are grounds for the belief that this is no longer the case, at any rate that British firms are rapidly qualifying to meet all requirements. This view is supported by Sir Charles McLaren's statement in his speech to the shareholders of the Metropolitan Railway Company, a few days ago. He said:—"The whole of their electric rolling stock, including locomotives, and the equipment of the line and trains, had been ordered from British firms, and, so far as the Board knew, had been constructed in this country. They had no reason to doubt that their decision in this respect would prove a wise one, and economical to the company. He believed that in no instance had they paid more than they would have paid had they placed their orders abroad." The action of the London, Brighton and South Coast Railway Company, as indicated by Lord Cottesloe in his statement to shareholders on January 31st, is not quite at one with that of the Metropolitan Company. Referring to the electrification of the South London line, Lord Cottesloe said that "the Company is now in active negotiation for a contract with the General Electric Company of Berlin, and it is proposed to require that, with the single exception of the motors for the first set of eight trains, the whole plant shall be of British manufacture." It may be hoped that before long railway and other companies requiring electric plant will as little dream of going abroad for it as their predecessors of fifty years ago thought of applying to foreign makers for the plant they wanted for their railways and their mills.

Electricity in Mills.—Reference has been previously made in these notes to the growing use of electricity for driving purposes in cotton mills, and an interesting allusion was made to it by Mr. G. F. Metzger, in a paper read before the Manchester Engineers Society last week. Mr. Metzger says that experiments in electric driving in cotton mills have been carried out with great success, and the advantages are demonstrable. Apart from the saving in building space, the reduction of running costs, and the application of either constant or variable speeds as may be required, electric driving in mills, by its flexibility and simplicity, generates increased outputs due to a higher speed, and a considerable saving in the cost per pound of the yarn produced. The mill owners are now persuaded of the practicability and advantages of the application of electricity, and a large number of the new mills now being erected are to be electrically equipped throughout. When bad times come again these more up-to-date mills will be in a position of great advantage as compared with concerns having only the old-fashioned plant.

The Rubber Companies.—It is perhaps permissible to take note of the number of rubber companies that are being floated in this country with large capitals for the purpose of rubber cultivation or collection. The demand for rubber has increased very largely in recent years, it may be expected to continue to increase, and the price of rubber is high in consequence. In these circumstances it is not difficult to frame an alluring prospectus intended for a public always attracted by the hope of exceptional gains. 300 trees to the acre, 3 lbs. of rubber to the tree, a net profit of 3s. per pound, and the sum works out £135 net profit to the acre. In view of statements of this kind it may perhaps be well to mention that the distance apart at which trees are planted varies considerably in different plantations. In Ceylon the commonest distance at which Para rubber trees are planted is 12 feet by 12 feet (290 to the acre). In the Straits Settlements the distance varies between 10 feet by 10 feet (435 to the acre) and 36 feet by 36 feet (33 to the acre). Mr. W. H. Johnston, Director of Agriculture, Gold Coast Colony, says that "probably the best results will be obtained by planting fairly closely, say from 15 feet by 15 feet to 20 feet by 20 feet apart, *i.e.*, 182 and 108 trees respectively, and afterwards thinning out weakly trees as they become crowded." So with yield. According to Mr. Arden's experience in the Malay Peninsula, the average amount of dry rubber obtained from a ten-year-old tree was 2 lb. 4 oz. The late Dr. Trimen made experiments in Ceylon which gave an average yield per tree from the twelfth to the twenty-first year of about $1\frac{1}{2}$ lb. per acre. Much depends upon soil, climate, and cultivation, and expenses vary in different countries in proportion to the cost of labour, land, and transport. That at present prices a well-managed rubber plantation gives a handsome yield upon the capital employed is certain, but the rubber area of the world is practically unlimited, and with the immense extension of rubber cultivation now going on supply may soon be expected to overtake demand and lower prices.

CORRESPONDENCE.

"CASH ON DELIVERY."

With reference to the notice in the last *Journal* of the "Cash on Delivery" system, I venture to hope that nothing will be done by the Society of Arts or its members to encourage the introduction of this system, for which there is no real demand or necessity in this country. Living, as I do, near a small country

town or village, also not far from London, I am well aware of the difficulty which the small shopkeepers already experience in making a livelihood, and they are a class which we do not wish to see squeezed out from the provincial community. Already they are greatly handicapped by the practice of many residents in dealing with the London stores, and of some, I am sorry to say, who, while owing accounts to shopkeepers here which they do not pay, or at any rate within a reasonable time, transfer their custom to those stores or to other shopkeepers in London or outside of their own locality. The "Cash on Delivery" system is expressly designed to induce or facilitate this distant trading, and would certainly be most injurious to the interests of the class I speak of, while not meeting any real requirement of the public. It may have succeeded in France; but I should like to hear the opinion of the French provincial shopkeepers on the subject. Besides, it is not really a part of legitimate Post-office business, of which there is quite sufficient already in this country to keep the Department fully employed.

LOWTHER BRIDGER.

Old Manor House, Walton-on-Thames,
6th Feb., 1906.

OBITUARY.

LORD MASHAM.—Samuel Cunliffe Lister, first Lord Masham, died on Friday, 2nd inst., at Swinton Hall, his residence in Yorkshire, after a long continued illness. He was born at Calverley Hall, near Bradford, on the 1st of January, 1815, being the fourth son of Ellis Cunliffe Lister, a magistrate and member of Parliament for Bradford. He was the patentee of many inventions, amongst others the compressed air brake for railways and the wool-combing machine. Cartwright, the inventor of the power loom, invented a combing machine towards the end of the eighteenth century, but although many attempts were made to bring it into use, all these were unsuccessful. Lister gave his mind to the problem in 1843, and after many years labour he succeeded, and his machine revolutionised the worsted trade. In 1855 a dealer in London sent him a small quantity of silk waste, and he set himself with the greatest tenacity to the treatment of this waste, and in the end was rewarded with remarkable success. Mr. Lister was elected a member of the Society of Arts in 1870, and in 1886 he was awarded the Albert Medal "for the services he has rendered to the textile industries, especially for the substitution of mechanical wool-combing for hand-combing, and by the introduction and development of a new industry—the utilisation of waste silk." He was created Baron Masham in 1891.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

FEBRUARY 14.—"The Horseless Carriage, 1885–1905." By CLAUDE JOHNSON. COLONEL H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 21.—"The Fisheries of the North Sea." By WALTER GARSTANG, M.A. EDWIN RAY LANKESTER, M.A., LL.D., F.R.S., will preside.

FEBRUARY 28.—"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.). SIR JOHN WOLFE-BARRY, K.C.B., LL.D., F.R.S., will preside.

MARCH 7.—"Art in Painting and Photography." By J. C. DOLLMAN, A.R.W.S. DAVID MURRAY, R.A., will preside.

MARCH 14.—"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE.

MARCH 21.—"Motor Boats." By BERNARD B. REDWOOD, B.A. SIR JOHN I. THORNYCROFT, LL.D., F.R.S., will preside.

Dates to be hereafter announced:—

"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.

"Submarine Signalling." By J. B. MILLET.

"The General Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"Industrial Russia." By LUCIEN WOLF.

"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT.

"Power Transmission and Coal Conservation." By ARTHUR J. MARTIN, Assoc.M.Inst.C.E.

"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By PROFESSOR THOMAS OLIVER, M.D., LL.D.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 15.—"The Navigable Waterways of India." By ROBERT BURTON BUCKLEY, C.S.I. The RIGHT HON. JOHN MORLEY, O.M., M.P., Secretary of State for India, will preside.

MARCH 15.—DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit., "The Languages of India and the Linguistic Survey."

APRIL 26.—COLONEL SIR ARTHUR HENRY MCMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 6.—"Imperial Questions in the West Indies." By SIR NEVILE LUBBOCK, K.C.M.G.

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

FEBRUARY 20.—"Illuminated Manuscripts." By H. YATES THOMPSON, F.S.A. The HON. JOHN FORTESCUE, King's Librarian at Windsor Castle, will preside.

MARCH 20.—"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A. WILLIAM A. LINDSAY, K.C., Windsor Herald, will preside.

APRIL 24.—"Cut Glass." By HARRY POWELL.

MAY 24.—"Basket Making." By THOMAS OKEY.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." Five Lectures.

LECTURE III.—FEBRUARY 12.—Armaments—Progress in the design and manufacture of guns, mountings and machinery for working heavy guns—Improvements in projectiles and explosives.

LECTURES IV. AND V.—FEBRUARY 19 and 26.—Recent types of warships, British and Foreign—Battleships—Armoured and protected cruisers—Scouts—Torpedo boats and destroyers—Submarines.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Sir William White, "Modern Warships." (Lecture III.)

Mechanical Engineers, Storey's Gate, Westminster, S.W., 8 p.m. (Graduates' Lecture.) Professor W. Cawthorne Unwin, "The Niagara Power-Stations."

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. Marshall's paper.

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Rev. W. S. Green, "Geography of the Spanish Armada."

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, JAN. 13...Asiatic, 22, Albemarle-street, W., 3 p.m.

Royal Institution, Albermarle-street, W., 5 p.m. Prof. W. Stirling, "Food and Nutrition." (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Frederick Robert Upcott's paper, "The Railway Gauges of India." 2. Mr. John Eaton Blackwall, "Country Roads for Modern Traffic." 3. Mr. George Robert Jebb, "A Plea for Better Country Roads."

Photographic, 66, Russell-square, W.C., 8 p.m. Annual General Meeting.

Anthropological, 3, Hanover-square, 8 p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. The Hon. J. G. Jenkins, "Products of Australia."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8p.m.

WEDNESDAY, FEB. 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Claude Johnson, "The Horseless-Carriage, 1885-1905."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Association of Engineers in Charge, St. Bride's-Institute, Bride-lane, E.C., 7½ p.m. Mr. H. C. H. Shenton, "Small Water Supplies."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, FEB. 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. Robert Burton Buckley, "The Navigable Waterways of India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. J. J. Simpson, "The Structure of Isis Hippuris (Linnæus)." 2. Mr. W. B. Daydon Jackson, "Note on the Geographical Distribution of the Genus Shortia (Torr and Gray). 3. Dr. H. Charlton Bastian, "Developmental Changes in Zooglœa."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. A. Angel, "Cuprous Formate." 2. Messrs. H. Hartley and N. G. Thomas, "The Solubility of Triphenylmethane in Organic Liquids with which it forms Crystalline Compounds." 3. Mr. H. Hartley, "The Spontaneous Crystallisation of Supersaturated Solutions." 4. Messrs. H. A. D. Jowett and A. C. O. Hann, "The Preparation and Properties of some new Tropeïnes." 5. Mr. A. McKenzie, "Studies in Asymmetric Synthesis." Part IV. "The Application of Grignard's Reaction for Asymmetric Syntheses."

Royal Institution, Albermarle-street, W., 5 p.m. Mr. H. B. Irving, "The English Stage in the Eighteenth Century." (Lecture I.)

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m. Annual Meeting.

Numismatic, 22, Albemarle-street, W., 6½ p.m.

FRIDAY, FEB. 16...Royal Institution, Albemarle-street, W., 9 p.m. Mr. W. C. Dampier Whetham, "The Passage of Electricity through Liquids."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m. Mr. J. M. Moncrieff, "Commercial Dry Docks."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Papers on "Cold Wought Iron," and "The Tempering of Steel."

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m. Annual Meeting.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Mr. G. J. Churchward, "Large Locomotive Boilers."

Geological, Burlington-house, W., 3 p.m. Annual Meeting.

SATURDAY, FEB. 16...Royal Institution, Albemarle-street, W., 3 p.m. Mr. M. H. Spielmann, "George Frederick Watts as a Portrait Painter." (Lecture I.)

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FRIDAY, FEBRUARY 16, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 19, 8 p.m. (Cantor Lecture.) Sir WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." (Lecture IV.)

TUESDAY, FEBRUARY 20, 8 p.m. (Applied Art Section). H. YATES THOMPSON, F.S.A., "Illuminated Manuscripts."

WEDNESDAY, FEBRUARY 21, 8 p.m. (Ordinary Meeting.) WALTER GARSTANG, M.A., "The Fisheries of the North Sea."

Further details of the Society's meetings will be found at the end of this number.

EXAMINATIONS.

The Society's Examinations will commence on Monday, April 2.

The last day for receiving applications from Local Committees is Wednesday, the 28th February, 1906, and after that date none will be received under any circumstances whatever. Application forms from the Provinces should therefore be posted not later than Tuesday, the 27th February. Committees may, however, close their entry lists at an earlier date, if found desirable.

The following is the Time Table :—

	Monday, April 2. (7—10 p.m.)	Tuesday, April 3. (7—10 p.m.)	Wednesday, April 4. (7—10 p.m.)	Thursday, April 5. (7—10 p.m.)	Friday, April 6. (7—10 p.m.)
Advanced Stage.	Book-keeping. English. Economics. Danish and Norwegian.	Arithmetic. Commercial Law. German. Italian. Spanish.	French. Commercial History and Geography. Typewriting (7.30 to 10 p.m.).	Accounting and Banking. Shorthand (150 and 120 words per minute), (7.15 to 10 p.m.)	Portuguese. Précis-writing. Russian. Swedish. Chinese. Japanese. Hindustani.
Intermediate Stage.	Typewriting (7.30 to 10 p.m.). French. Danish and Norwegian. Commercial History and Geography.	Book-keeping. Précis-writing.	English. Economics. Spanish.	Arithmetic. German. Portuguese. Italian. Russian. Chinese. Japanese. Hindustani.	Swedish. Shorthand (100 and 80 words per minute), (7.15 to 10 p.m.).
Elementary Stage.	Handwriting and Correspondence. French.	German. Italian. Typewriting (7.30 to 10 p.m.).	Book-keeping Spanish.	Shorthand (50 words per minute), (7.15 to 10 p.m.).	Commercial Geography. Arithmetic.
Music.		Harmony.	Rudiments of Music (7 to 9 p.m.).		

Copies of the Programme for 1906, with full details, together with the questions for 1905, and reports by the Examiners, can be had, price 3d., on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, London, W.C.

The questions for the years 1900, 1902, 1903, and 1904 can also be obtained (price 3d. each year) on application as above.

CANTOR LECTURES.

SIR WILLIAM WHITE, K.C.B., F.R.S., delivered the third lecture of his course on "Modern Warships," on Monday evening, February 12th.

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, February 15; The RIGHT HON. J. E. ELLIS, M.P., Under-Secretary of State for India, in the chair. The paper read was, "The Navigable Waterways of India," by ROBERT BURTON BUCKLEY, C.S.I.

The paper and report of the discussion will be published in a future number of the *Journal*.

FLEMING'S "HIGH FREQUENCY CURRENTS."

Professor J. A. Fleming's Cantor Lectures on "The Measurement of High Frequency Currents and Electric Currents," have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, February 6; SIR WESTBY B. PERCEVAL, K.C.M.G., in the chair.

The CHAIRMAN said that all present would regret the absence of the Earl of Elgin, who was prevented from presiding by reason of attendance at a Cabinet Committee meeting. The duty of taking the chair devolved upon him as Chairman of the Colonial Section, and in that capacity it gave him very great pleasure to introduce Mr. Beale, who was to read a paper on "Imperial Immigration." The author would be especially welcome because he came fresh from Australia, and had had special opportunities of gauging public opinion there, not only from his position as President of the Federated Manufacturers' Association of Australia, but also owing to the fact that in that connection he was naturally brought into close contact with the various labour organisations, whose opinion on this subject was perhaps of even more value than the opinion of the manufacturers.

The paper read was—

IMPERIAL IMMIGRATION.

By OCTAVIUS CHARLES BEALE.

The turmoil of Parliamentary elections being over, the attention of thinking men is once more directed to the exigencies of daily life, to the national outlook upon industry, to the ever-present question of Imperial cohesion.

Five years ago Prince Herbert Bismarck, in his electoral district, addressed the good burghers of Burg and Genthin upon broad subjects of interest. He quoted a declaration, "von höchster Stelle gethan," meaning, of course, the present Emperor, "We Germans need not despond in difficult case, because we can count on Almighty God as the best of allies." But Fürst Herbert added, "We must not leave the old phrase out of account—'God helps him who helps himself.'" And speaking of the *Stetigkeit*, the continuity, which makes the strength of a Government and raises it in respect, he quoted words from a speech of his great father delivered in 1868 in the Prussian Parliament, which I translate as follows:—

"In almost every concern choice may be made of two or three paths—which is the right one, which is mistaken, the future will decide, when not one of us perhaps is living, but the way by which a Government goes down to ruin is when it does first one thing and then the opposite, when it consents to-day and to-morrow does not follow up, for a Government must not vacillate. Once it chooses its path then it must go forward, looking to neither right nor left. If it vacillate it becomes weak and the whole State suffers."

Those are the characteristically simple and direct words of the greatest statesman of his generation, and they have application only too painfully to our own far-spread ocean-empire. Last year the central Government, the mother State, projected a working policy, a business plan already initiated—be it ever remembered—in the great transmarine self-governing States of the Britannic Union. In this Union there is no free-trade between its parts, no approach to freedom of interchange. Each of the several nations of the outside world governs its affairs upon the principle of self-protection, of self-preference, of inflexible determination to conserve its own industries. By elaborate and painstaking discrimination in the levying of tariffs upon foreign goods each nation develops all possible fields of production within its boundaries, and thereby—as industry is the only civilised method—it raises its own pros-

perity by the improved remuneration of its own workers.

That which each of those foreign nations made its aim has in every case been attained, for industry cannot be overrated and always has its reward. In every kind of material advance, in the evocation of faculties, in education, in technical instruction, in the elevation of craftsmanship, in invention, discovery and practice, in lessening working hours, in hygienic improvement, in physical well-being and mental cultivation; in the acquisition of wealth and of national strength, that bending of legislative and administrative energy to the furtherance of industry has everywhere amongst those nations had its reward. In each of them occupation has been augmented until few willing citizens are unoccupied, and in each of them pauperism has diminished.

But the policy of national preference, that path indicated by the oversea statesmen and adopted by the daughter States of our Empire, has been rejected by the mother State. Another path has been chosen, different from that taken by foreign nations, opposed to that chosen by the Colonies, and "whether it be the right one, or whether it be mistaken, the future will decide." Meanwhile, to quote the great Bismarck's phrase, "wir kommen ins Schwanken," we become irresolute, we vacillate. Opinion at the centre controverts all other so that we cannot agree as to a working principle. One thing in the strange confusion is clear. The loyal perception of the self-governing oversea States will not and cannot lead them astray. Whatever happens there will be preference to the Motherland and they will await with smiling calmness the time when Old Britain, for her own sake, shall respond.

There, then, are those vast dominions of Australia, New Zealand and Canada, eight millions of square miles, loyally preserved by the transplanted British democracies as a sacred trust for those in the old land who may wish to follow. Many of us in Australia have held the view that it would tend to the more rapid development of the country if land grants on a large scale were made to private railways so as to open up the interior to settlement, yet the voters have held that such lands should not be alienated in large blocks but preserved for those of our kin who had not left the old home. Probably a mistaken conclusion, but no one can deny that the argument has been strenuously employed.

I have no claim or qualification to speak for the other States of the Empire, and shall therefore limit my remarks upon the matter of attractions to immigrants to the Commonwealth of Australia, in all of whose States I have been, and am still, engaged in business, and am again directly connected through our industrial organisation, the Associated Chambers of Manufactures. At this juncture in Imperial politics it may be especially opportune for those who are casting their eyes afield to take account of the opportunities afforded for industrial development by the Australian States, and narrowly to enquire for themselves, throwing aside all casual opinions stated by superficial observers. As President of the organisation mentioned I have had special facilities for observing the work done and the progress made in Australia in the handicrafts as well as in what is somewhat loosely called primary production.

Of the stupendous potentialities in agricultural, pastoral, and mining pursuits, you have often heard, yet of them no man can convey an adequate idea. In the beginning of the nineteenth century there were eleven merino sheep in Australia, all told. In the lifetime of a man these had multiplied ten million times, and it is worth remembering that in the climates where the merino thrives the Caucasian race also thrives best, for mortality is at its lowest. You have heard of droughts, which are indeed meteorological phenomena in the nature of normal conditions to be reckoned with and provided against. In New South Wales, in the memory of man, one crop, and only one, has failed. Yet that is emphasised in this country and the regularity of the progress of agriculture has had scant notice. Outside of the dividing range in that State the rainfall at its lowest has never been as low, in the worst of seasons, as the average rainfall of London. Inside of the range are the great sheep pastures where the constant multiplication of wells, of waterworks to conserve the supplies of rivers and creeks together with storage of fodder, is gradually enlarging the control of man over the vicissitudes of climate. In Western Australia are wide areas where drought has never been known and an annual rainfall of 40 inches is constant. As to the State of Victoria, a better illustration of the success of that control can hardly be given than the following table of the butter export, extending over the sixteen years of the history of that industry:—

Statement showing quantities and values of Butter exported from Victoria for the past fifteen years.

Season.	Quantity. Tons.	Value. £
1889-90	369¼	50,300
1890-91	759¼	91,200
1891-92	2,139½	225,400
1892-93	3,613½	404,432
1893-94	7,652¼	761,273
1894-95	11,584¾	1,081,243
1895-96	9,386	901,000
1896-97	9,895½	942,247
1897-98	7,175	670,000
1898-99	9,744	974,400
1899-00	17,107	1,604,600
1900-01	16,163	1,664,790
1901-02	11,152½	1,226,775
1902-03	8,565	1,278,059
1903-04	14,736	1,444,167
1904-05	16,381	1,654,481
Total	146,423½	£14,974,367

In everything that is young and healthy growth is rapid, the ratio diminishing as maturity is approached. Other countries, as also other States of the Empire, demand a share of the butter trade of England which the Empire itself could later very easily supply, therefore enterprising Victoria may well be content for a while with her present output. But it is interesting to note how small, comparatively, was the check caused by the recent dry seasons and how quick the rebound since.

Regarding live stock and the influence of seasons. The first and chief cause of the sudden and repeated losses by Australian stock-owners was that inevitable "swing of the pendulum" of which we have heard and seen so much lately, whose startling consequences remind us again of the Bismarckian text at the beginning of this article. It may be allowed that too much of the choicest lands was devoted to pastoral occupation. Democracy loves war-cries, a kind of atavistic survival, and as we are all democratic in Australia, having attained in adult suffrage what is surely the high-water mark of democracy, we can afford to find fault with ourselves. Yes, even if a kind friend were to heave at us the second-hand sarcasm that "there are people whose very self-blame is a kind of oblique praise, as showing how much they can afford." Well, the lands were wanted for agricultural occupation and there was the chance for demagogues and declamation. No language too hard, no treatment too harsh, for pastoral tenants who were, a generation ago, dispossessed amid rejoicings. With uncertainty of tenure provision was not usually nor adequately made for the conservation of water and fodder hereinbefore described, so that when adverse seasons came, as come they must, there was no control. We suffered a huge diminution in our chief asset, and we learnt our lesson. We have come to see the importance of our stock industry, as we are learning fast in the face of the bitter doctrinaires of the "free-trade" press, to value every loyal industry be it great or small. And thus length and security of tenure is easily obtainable by pastoralists, big or little, and no country can or does offer greater possibilities to the investing immigrant who would follow the first; the favourite, and most fascinating of all avocations, the breeding of cattle, sheep and horses. Statistics must be quoted but in such an article they must be made salient, "jumping into the eyes" as the continental idiom has it.

New South Wales is the chief pastoral State with more than half of the sheep of Australia. Of about 200,000,000 acres, one-fourth has been alienated. From the remaining 150,000,000 choice can be made, not from all, but from more than enough. Do you imagine to yourselves what such a figure, so glibly stated, means? The unsold lands of the State of New South Wales, fourth in size, smallest but one on the Continent of Australia, are in area equal to a belt 10 miles broad at the Equator right round the globe. The area of Western Australia is equal to a belt around the globe 40 miles broad. These are ideas very easy of conception but so stupendous an extent is beyond the comprehension of man; and remember that over those limitless domains men of your race can preserve health, and work without coats, if they will, in the open air all the year round. Space will not permit of details of terms of occupation, but the one illustration of Queensland may suffice. Areas up to 60,000 acres may be obtained for periods up to 28 years at from one half-penny per acre per annum. Areas are classified, yet half the quantity at double the price would only mean £125 a year, and there is no taxation on leased lands. There is no part of the world where greater inducements are offered to intending pastoral settlers than those afforded by the Australian States; nowhere is there herbage so well suited to fine-wooled sheep, nowhere so rich an endowment of natural fodder plants. Of these the saltbushes (*rhagodia* and *atriplex* in great variety) are the finest fodder plants

existent on the planet. These shrubs are not only nourishing to the animals but possess special health-giving properties, are drought-resisting, rapid in growth, easy of propagation. They have an exceptional quality of absorbing sodium chloride instead of, or in addition to, the potash salts as secreted by other plants.

An instructive monograph upon this, an essentially important matter to the pastoralist, is obtainable in Australia and an exceedingly interesting essay upon our pasture plants by Mr. Fred. Turner, F.L.S., is published in the 300-page pamphlet "Australian Industry," shortly to be issued here by the Federal Council of our Chambers of Manufacture. Finally, it may be mentioned that the States of West Australia, South Australia and Queensland, offer at present the best inducements for pastoral settlement on a large scale. In the first-named, the pastoral area is 230,000,000 of acres.

Of horses, we possess 1,600,000, a military potentiality not to be overlooked; of cattle there are 7,750,000, and of sheep there are 75,000,000.

Outside of Australia but little of the planet is known to be suitable to the growth of merino-sheep. Rabbits are no longer regarded, with possible exception of Queensland, as an unmixed evil, and the closer the occupation the better the control. There is no known limit to the pastoral resources of the continent, and what is wanted to develop them is a constant stream of men of our own race to do what their predecessors have done, face and conquer the difficulties and asperities of Nature. They will enjoy their success in quiet assurance with none to make them afraid.

Here it may as well be said at once that the settled policy of the Commonwealth is a White Australia. There is no body of men there which now opposes that policy. Servile labour is not obtainable and the introduction of it will assuredly not be permitted. There are four millions of your own race there, sturdy and resolute, very much maligned, subjected to a torrent of savage acrimony from certain London newspapers because of their determination, yet they are determined. Over all that wide Continent washed by two oceans and many seas are scattered a vigorous people of your own blood. In that huge expanse there has never yet been a cannon-shot fired in anger and we have rejoiced in the abundance of peace. Yet within a few days of our shores are the old lands with dense population from beyond the dawn of history, and they now contain two-thirds of the human race. Ours is the last great outpost of the Britannic Union, dividing East from West. True, we have faced no war, civil nor foreign, but there has been a long, relentless fight against Nature in her most appalling austerity. There can be nothing which will evoke all that there is in a man of courage, self-reliance, and resourcefulness than the fact of his being alone in the far wilderness 500 miles from help, with nothing but the qualities of his own mind and physique to save him to those he loves and himself from a cruel death. And those British people, respecting their pioneers, sport-loving throughout, *au courant* with passing events, sharing with infinite pride in the past glories of their nation, are more than willing to assume their share of its burdens and its dangers. They take the family abuse into the bargain, but they like that least. By raising their hand, by a stroke of the legislative pen, they could admit, as they have been urged by loquacious enthusiasts to admit, millions from the coloured races around them to do the work that they are—thank God—willing to do themselves. They are resolved to hold, through evil report and good report, Australia as a domain for those of their own race first and for other European races after. Some of you may deem it folly. We think we have already proved the wisdom, but there can be no mistake that that is the path chosen, whether the right one or the mistaken the future will decide, when perhaps not one of us is living, and we shall continue in it without vacillation. In a paper upon Imperial Immigration this explanation is inevitable.

Before turning from the subject of pastoral pursuits it should be mentioned that whereas in 1891 there were 107,000,000 sheep and now about 75,000,000, the value of wool in the former year was £20,500,000 sterling, and for the year just closed probably £20,000,000, or nearly the same value.

Next in importance comes the great mining industry. In 1903, the latest year for which complete figures are available, the value produced was £24,000,000 sterling. How little is it known in Europe that in Australia nothing is allowed to block the mining for precious metals, not even the freehold of land. For the sum of five shillings a right of protection can be obtained ensuring to the would-be miner the opportunity to seek for and keep for himself without royalty, the metal desired. In this respect again objection is raised, with

extreme acerbity of language, to our very democratic legislation. I have heard foreigners declaim with vehemence against such an even-handed system. It was declared that we ought to allow outsiders, or anyone, to acquire the freehold of auriferous or mineral lands at low prices, to work or not work, as being their very own. That means plutocratic control without rendering society any service, and Australia will have none of it. Yet we will point out auriferous deposits known to contain great quantities of gold which as yet no man is able to extract commercially. If anyone has the skill, or the perception, to win the precious metal, he can have with welcome all the fortune he may derive from it, with none to say him nay. Bit by bit those problems are being solved and as metallurgical knowledge extends the area of operations is increased.

We have it on first-rate authority, out of the fierce controversy now raging in England with regard to labour in the Transvaal, that the costs of mining and extraction there are 23s. per ton of ore. We have it upon similarly first-rate authority (Messrs. Bewick, Moreing and Co.) that the cost of mining and extraction in the case of 18 important mines under their direction in West Australia, is the same figure, 23s. per ton. But to quote the words of the eminent expert, Mr. Hoover, of the firm named:— "There are in that State (Western Australia) scores of 6 dwt. mines (that is to say, yielding ore to about the contents value of 23s.) which to-day begin to rank as mines . . . . One of our mines is to-day paying a profit on 4 dwt. 9 gr. per ton (say 17s.). In the future 4 dwt. mines will be the backbone of the industry. On a 4 dwt. or even 5 dwt. basis, the Kalgoorlie mines would be larger employers of labour and in reality larger mines than ever before, and more, they would extend to the greatest depth that could be worked on probably slightly better grade than this." Those are the words of Mr. Hoover, and that is the best news ever uttered about mining in the West or any other part of Australia, for it shows the capacity of your own race and what may confidently be expected from them. The mineral area of the State named alone is stated at 500,000 square miles, say, 300,000,000 acres, so that there exists the most ample field in all the world for the prospector, miner, and metallurgist. The *auri sacra fames* has converted a dreary patch of lonely, waterless desert, 450 miles from the coast, into a busy town of 30,000 inhabitants—Kalgoorlie. There can be seen a gigantic installation of the latest mining machinery, comfortable hotels, with brilliantly-lighted and commodious tramcars whizzing about which might well make the Chicagoan, the New Yorker, or Londoner turn green with envy to behold. Water is pumped 423 miles up a rise of 2,380 feet to supply the railway and town. Where but a very few years ago was a hopeless wilderness, gardens and even flower-shows tell the immigrant in sweetest language that there no labour is menial, nor is the Caucasian played out. Just a few figures. In 1899 in West Australia 1,200,000 tons of ore were mined, crushed, and treated by 16,000 men, value per ton 99s. 6d. Five years later 2,400,000 tons were handled, just double, by 16,800 men, yield 66s. 3d. So, with a few more men, twice the quantity was worked and although the yield per ton was one-third less the dividends were increased by £650,000. That is a comprehensive illustration which should give hope and confidence to those who are competent to embark in the mining industry. It is the most generous of industries, for there is no selling competition and every colleague will teach what be knows. There is room for him and room for all.

Agriculture.—After the enormous figures of pasture and mining it seems small to quote the yield of wheat, 65,000,000 bushels for 1905, not the most favourable year, yet not far behind that of our great sister Canada. Two years ago we surpassed the yield of Canada, and assuredly no man can say what are the limits of Australian production. That the Commonwealth could supply the British Isles besides supplying itself there can be no doubt. The area under cultivation shows in all the States excepting South Australia a satisfactory increase. Probably the reason why the latter has remained stationary is that she was the chief supplier for many years of grain and flour to her sister States, who now produce their own requirements. Again, many of her farmers have migrated to Western Australia, breaking up new ground and, as is usual where gold deposits are worked by British people, attacking the soil, whether likely or unlikely, with the view of supplying the miners' wants. Miners and those serving them always form a desirable market for the farmers who follow. Prices are good and customers generous. The student of statistics cannot fail to be gratified with the steady and uniform progress of Western Australia in all

departments, without exception, of pasture and agriculture. To those of us who are in middle life, twenty years are but a short period, and here, shortly stated, is the movement of figures. In number horses have more than doubled, cattle multiplied eight times, sheep doubled, swine multiplied three and a-half times, acres cultivated four and a-half times, wheat production five times, oats nine times, hay four and a-half times, potatoes four times. Being the youngest sister we take much pride in her and claim excuse for showing favour. In pastoral products she has doubled, and in dairy products nearly trebled the results of twenty years ago.

The immense yields of Australia in pastoral, agricultural, and mining products, as is well-known, throw all other countries of similar population completely in the shade. In gold yield she heads the United States with her 83,000,000 of people and the same extent of territory. She has practically a monopoly of fine wools, and as many sheep as the rest of the British Empire. She has startled the world-markets in silver and lead, and may do the same next year in zinc. In wheat she runs Canada close. Her butter trade averages not a dozen years in age, yet in 1904 she exported 32,000 tons. But there is another side to the story which must be told, and here I come to the heart of my subject.

It has been well said that "no nation has ever achieved greatness which depended upon the export of raw products." The entrails may be ripped out of a country in the shape of timber, and coal and copper, and gold and silver, and even animal products, creating statistics that are received with whoops of joy. A million of money's worth in raw products may, and often does, represent no more to the producing country than the wages, small or large, spent there and sometimes not even that. That million may be owned outside and often is. Butter is hardly a raw product, for the value of the wages over that of the mere pasture in the whole value must be considerable. And so in an ascending scale the value of the product to the producing country rises with the wages-expenditure in that country. Now, when the manufacture of goods is completed in the country from her own raw products, the whole value is to the good. Where we ship wool abroad at a shilling a pound and re-import it at 6s. a pound as cloth we fall into debt for the difference. The illustration must be taken as the principle, for this paper is not to be a disquisition upon self-containedness in nations. We shall use no other neologism. To say self-sufficiency would provide our dear friends the enemies which are of our household with a fresh sneer. But it is quite safe to say that we want to be self-sufficing.

Australia of all things needs immigration of manufacturers, their skill and some money. If their position is good elsewhere there is plenty of money in Australia, so that it is not necessary that a manufacturer should take all the requisite means with him. As a matter of course his project and the security will be narrowly scrutinised, yet he will find ample financial facilities in the usual course of banking, with a distinctly friendly leaning on the part of the great banks towards business enterprises whose nature is that of supplying locally the ordinary requirements of civilised life. He will receive the most kindly and courteous treatment and plain explanation of their usual methods of dealing from the London offices of those institutions. Exports from the Commonwealth now exceed the imports in value by £20,000,000 sterling annually. Whereas, five years ago, each State having its separate Customs Tariff each of the six imported manufactured goods chiefly from abroad, now each of the six imports from its sisters greatly to the support and development of their entire industries, be they primary or secondary. The cost of tilling the soil and the cost of harvesting have both been reduced by machinery of Australian invention to a figure not excelled elsewhere. Which is the primary industry, as so much stress has been laid upon the adjective, the making or the driving of a plough? Say that the calling of the implement-maker is only ancillary, he demonstrably designs the requisite instruments at the time, in the place, and in the quantity needed. He devises the desired improvements and alterations, some of them altogether unique. And so from the elementary to the complex, from making ploughshares of unsurpassed quality to the production of ladies' mantles and jewellery, with a thousand gradations between, developmental industry is constantly diversifying its operations in Australia. Yet, just as the hardy pioneer has to face Nature in her most hostile and forbidding aspect in a foodless land, conquering for mankind a continent opulent in potentialities, so the Australian manufacturer has had to face an austerity of opposition almost beyond belief.

Let those who are interested peruse the

sworn evidence before the present Royal Commission upon the Tariff, where it deals with this matter. Had manufacturers been traitors and enemies to the State, the language employed by a large section of the Press in the cities of Melbourne and Sydney could not have been more savage in its persistent malignity. I have before me the Report of the Commission, a bulky volume still incomplete, in which details are set forth as to the vituperation alluded to, and it is entirely uncontradicted. There are indeed newspapers which have vigorously protested against such unnatural and unpatriotic sentiments and I carry cuttings from them. My colleagues seldom reply to such assaults and I can remember no instance in which the epithets commonly applied to us have been thrown back at our detractors. We have been designated by these newspapers and by the members whom they have succeeded in returning to Parliament, "robbers, cormorants, plunderers, parasites, pirates," and many other terms of opprobrium calculated more or less to irritate and especially to injure. According to my own immediate observation the men of whom during very many years volumes of denunciation have been thus printed and circulated, are earnest, anxious, capable, honest and industrious citizens, loyal and Imperial to the core, applying themselves to difficult industries of the highest value and importance to society. In all of the States our organisations have debated with great solicitude the best means of contradicting by plain, mercantile methods this unsleeping antagonism to which alone the Press partisanship gives weight. We have decided that public exhibitions of our products would be an effective cure and have experienced success in this method beyond expectations. Of late there has been some diminution in the asperity of the Press writers and it is certain that from the industrial standpoint, the immense advances already made ensure the conquest of wider fields of industry at present not exploited. Attempts are now made, healthiest of signs, to explain away the attitude and the epithets complained of, as being "Pickwickian," an insult to his master that Sam Weller would be prompt to avenge. I have deemed it best to candidly declare that which will be found in the report mentioned, as also in the files, for many years past, of papers issued in the cities named. Wherever it may be, there is no royal road to success in manufacturing enterprise. It is always *per ardua ad astra*, "*Der Mann muss hinaus ins feindliche Leben*."

When that is told, the worst is known. The *bête noire* of intending investors is the "Labour Party." Another hobgoblin is the industrial courts of the different States. How shall we illustrate the true position? Take as an instance that one of our members which is the richest, the oldest and the largest employer of labour, brains and skill in Australia. The Colonial Sugar Refining Company utilises a capital of several millions sterling, has attained its fiftieth year, celebrated its jubilee by building offices which are an ornament to the city of Sydney, paid its highest dividend, and has never had at any time in its history a dispute with its *employés*. As President of the Associated Chambers of Manufactures I have with my colleagues often visited our friends the presidents of trades' and labour councils, and they visit us. We meet at our several functions, we agree and we differ fraternally, for there is nothing at all of the acerbity of language and rancorous antagonism that it is our custom to endure from those opposed to us, who are not of the labour party or of labour organisations. That antagonism is directed against employers and employed in manufacturing industry. As to industrial courts, our councils generally are of opinion that the decision of trade disputes by appeal to some ratiocinative process will continue. We believe that the strike and lock-out will be less resorted to until they finally disappear as did other barbaric practices. We deem the present method of settling disputes in those courts to be imperfect. So are other courts imperfect, but we agree that effort must be made to devise effective appeal to reason instead of to force. In our industries we deal with a highly intelligent and energetic body of workers numbering scores of thousands, in our pay, who are all white and mostly British. They work 48 hours a week, and the judgment of my *confrères* generally is that as good work is obtained in those hours as is obtained elsewhere in longer hours. The impression which I wish to convey is that my colleagues regard the type of workpeople with whom they have to do as at least equal to any others elsewhere. I have often heard it said that Australian workers are superior in intelligence, quick in perception, alert and possessed of good taste where artistic perception is of value in their work. From a wide experience in Australasia that is my own judgment. They will accord

and they will expect respect; but haughty treatment will always fail. To the manufacturer who can get along with his own race Australia offers diverse attractions. The household enemy is not by any means the wage-earner.

The first great demand of Australia is the comprehensive production of iron and steel from her own ores. We shall then get these basic articles at half their present, imported, cost. Just as we now supply ourselves with the purest of all salt, another basic article, at less than half the price we were compelled to pay the European Salt Trust. Coal is so abundant and cheap in New South Wales that it can hardly be said in places to add to the value of the surface. Coal is drawn out of the adits by ponies which costs only 3s. to 3s. 6d. per ton when tipped into the furnaces. Beside it are permanent water and an inexhaustible field of limestone, both on a railway line. Rates of haulage on minerals are very low, and there is no possibility of a crushing competition by rebates as in America. There are enormous deposits of iron ore of richness varying from 60 to 90 per cent. The chemical composition has been found satisfactory by experts from Europe, and these deposits are usually alongside deep water, thus facilitating transport. At Burnie, in Tasmania, the deposit from water-level up is estimated at 20,000,000 tons. In New South Wales the deposits are, within sight, 60,000,000 tons. The deposits known as the Iron Knob and Iron Monarch, near Port Augusta in South Australia, are stated to contain 20,000,000 tons. In these instances no estimate can be made of the quantity beneath the ordinary level of the country, and in no case is it said that the figures given by the geologists are comprehensive. The value of iron and steel imported in 1902, in the ordinary heavy lines together with machinery, was £4,500,000, which may be taken as normal. Had we local production and consequent diminution in prices the consumption would greatly increase within the Commonwealth, with a vista of trade to New Zealand, India and China. Already the State of New South Wales has contracted for seven years with a firm who undertake as the essential basis of the contract to supply all its requirements in iron and steel from ores smelted in the State itself. That is but a small part of the Australian demand.

Of woollens used in Australia we make but one-twelfth part. Mills are running with three shifts and my advices show them to be full of orders. And I am assured by mill-owners that they would welcome additions to their ranks from England, or elsewhere. It would be a mistake to suppose that low qualities are aimed at. Australian wools are the finest produced and there is choice of others on the spot. I can show a serge of quality unknown in Europe, which could be produced here of course, but which could not be surpassed.

During my sojourn in the United States I came into contact with a house, largest in its line anywhere, whom I urged to establish a manufacturing branch in Australia as they have already done in Canada and Great Britain. They are seriously considering the proposition, and may set a very desirable example there with the practical certainty of success.

It would exhaust your patience, for this paper is already too long, were I to recount the various avenues open to industries not yet effectively or comprehensively established in Australia. It must at least be emphasised that the industrial idea has taken firm root there as in Canada and in the United States. The vituperation before described we have survived and shall ultimately defeat. The attempts so often made to sow discord between workers have failed. The President of the Melbourne Labour Council, in an article upon the "Eight-Hours Day," published in a pamphlet issued by the Council of Chambers of Manufactures, writes: "By 'workers' I mean employers and employed." We live from day to day only by virtue of agreement, and the tremendous results achieved, which in this paper I have faintly touched upon, show that we agree to good purpose.

Australia, compared with Canada, has but two-thirds the number of inhabitants, yet our population has increased, decade by decade, up to the present, in a higher ratio than has Canada's. In productivity Australia is far ahead of Canada and is likely still more markedly to excel her sister. Of wool we produce annually forty times as much. Of sheep we have thirty times as many. Of cattle, we have one-half more. Of horses, the same number. Of wheat, we produce twenty per cent. less in actual figures, but *per capita* as much as Canada.

Australian minerals alone are in value about three times the total produce of Canadian mines, fisheries, and forests added together. Animal products of Australia exceed those of Canada in value by about two to one. Our

imports are £12,000,000 less than Canada's. Our exports are £11,000,000 more than Canada's. The bank and savings bank deposits are larger than Canada's.

But where Canada excels Australia is in the highly important field of manufacture, of developmental production. We do not envy, we take pride in, the splendid achievements of our Sister Dominion, attained as they have been by the exercise of foresight and determination. Whether free-trader or not, I have as yet met no Canadian business-man who denies that the protective industrial system, the discriminating tariff and local governmental preference to Canadian productions, has assisted to this great commercial success. Firms from the United States, because of tariff impositions, have established manufacturing concerns in the Dominion which they themselves declare, to my own knowledge, they would not otherwise have established. By the direct expenditure locally, but vastly more by the educative example, Canada has benefited and upon such lines cannot do otherwise than prosper. Her success is a brilliant incentive to Australia who has immeasurably greater natural advantages and facilities. The climatic range of the latter, and her mineral wealth, present to her opportunities unequalled by any other country. She has learned the advantage of free interchange between her provinces, that which is unmistakeably the true free-trade, and she begins to feel some security behind the slight protective fence which has been already erected.

When the generous-minded President of the Great Republic used the words "Beware of keeping the northern territory of your continent empty. Encourage the immigration there of southern Europeans. They will cultivate that rich country and become good Australians," I asked his permission to convey those sentences as a message to his Anglo-Saxon cousins in the Pacific, which he readily granted. Although he had never visited our country he displayed a surprising knowledge of its conditions and an exceedingly kindly interest. I think he offered the soundest advice which has yet been tendered for the solution of that, the most urgent and difficult of our problems. The *New York Tribune* of the 4th January reported that the largest individual cotton planter in Louisiana, Colonel Maxwell, had imported 20 Italian families and tested the results of their work on his plantations. He was so satisfied that he declared his intention of filling all his cabins with Italians as fast as they can be imported, and regards the cotton labour problem as solved. Apparently that would confirm Mr. Roosevelt's opinion. Colonel Maxwell is displacing black labour by white and the continued success of his practice should be cautiously imitated by Australia. Thus we may well render our tenure more secure whilst developing the great areas of well watered tropical lands of our Far North.

In a serious address upon this subject, Dr. Richard Arthur, M.P. of Sydney, President of the Immigration League of Australia, said: "In after days the historians of our land may find in Roosevelt's messages the most momentous utterances in our nation's story."

To strengthen the Empire we must build up our own race, mixing with it other European blood. We must develop industry that we may attract population, which will assuredly follow, and indeed the two things should proceed together. Free-trade between the several States of the Empire is a dream impossible of realisation, yet the aim of statesmen ought to be, and outside of Great Britain it is, to make the most of their own resources, to foster and conserve industry so as to construct a self-contained Empire within which we may work and rest in safety, to

> Mix with the poles the produce of the sun,
> And knit the unsocial climates into one.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said the paper was, as he expected it to be, instructive on the subject of Australia as a field for immigration. Those who knew Australia, its varied climate and soil, were perfectly well aware of the fact that portions of the continent were eminently adapted for what he might call close settlement, and that class of settlement in New Zealand, the colony which he knew best, had perhaps been more successful than in any other country. There had been a steady stream of small settlers from England to New Zealand for many years past, and that had been one of the chief factors in the success which had attended the efforts of the New Zealand Government, which encouraged the policy of land settlement in every possible way. The author had only incidentally referred to a subject which interested him particularly, namely, the attitude of the Governments of the various States in Australia, and also of the people themselves, towards the subject of immigration. It had often been said in this country, and possibly with some truth, that the working classes in Australia did not want immigrants from England. It would be interesting to have an expression of opinion from the

author as to how far he thought that statement was justified. Personally, he thought it was an exaggerated statement, and that both the Governments of the various States and the people themselves had shown by their acts that, so long as immigration could be conducted on sound lines, instead of there being any opposition, every encouragement was offered to it. The great difficulty was that England naturally did not want to lose her best people, and the Colonies naturally preferred the best to any other class. Emigration or immigration really meant the question of distributing the population of the Empire, and he thought it was one of the greatest problems which could occupy the minds, not only of the people of the Colonies, but of the Mother Country. It was an Imperial question, and seemed to him to affect both the trade and the defence of the Empire as a whole to such an extent that it was a matter of surprise to him that the Government of the country, and the various Governments of the Colonies, did not endeavour to take concerted action to bring about a system of Imperial immigiation. It was perfectly obvious that, if that had been done fifty years ago, and the stream of emigration from this country had been diverted to the Colonies, the Empire would have been in a very much stronger position than it was to-day.

Lord STRATHCONA, G.C.M.G., in referring to the absence of Lord Elgin, said that at such a meeting it wouldbe improper to introduce politics, and, as representing Canada, he knew no party politics either in Canada or in this country, but he was sure all present would have been glad to congratulate the Secretary of State for the Colonies on his appointment to high office, because he was a gentleman in whose hands he believed the interests of the Colonies would be perfectly safe,—one who had held the highest position already in India, and who had been entrusted with important duties by the recent Government in respect of the Commission on the South African war, and also a very delicate duty in connection with the enquiry into the relations of the two branches of the Church in Scotland. He was also sure their deepest sympathies would go out to Lord Elgin's colleague in the Foreign Office in his great bereavement. He had listened with the greatest interest to the paper, and congratulated Mr. Beale and all his Australian friends present on the admirable account he had given of the resources of Australia. It was one of the out-lying portions of the Empire of which all were proud, none more so than Canadians. He had nothing to say to the comparisons the author had made in regard to Canada and Australia. Comparisons had been described as odious, but he believed that what had been said in regard to both countries was, in the main, accurate. Canadians, however, were well satisfied with their own portion of the Empire, and, happily, Australia also seemed to be pleased with her lot. It might be the case that Canada had not the same rich mineral wealth as Australia, but in other respects Canada, as the author had said, was a little in advance of Australia. It was estimated that there were at least 171,000,000 acres of land in Canada fit for the cultivation and production, in the best possible condition, of wheat, which was a very great inheritance belonging to the Dominion and the Empire. In the present year there were about 180,000 farmers in the North-West of Canada, a country from which only thirty-five ago absolutely nothing was exported with the exception of the furs collected and sent to England by the Hudson's Bay Company. Last year no less than 90,000,000 bushels of the finest wheat were grown in the North-West alone, and, together with other grain, the total amounted to at least 140,000,000 bushels, for which the 180,000 farmers would receive over 100,000,000 dollars. He thought the Canadian farmers were to be envied when that fact was compared with the present state of agriculture in this country. Canadians did not envy but congratulated Australia on her great advance. Probably, as in Canada, it would be a great advantage to Australia to have a larger immigration; and instead of being jealous of Australia taking means for adding to her population from Great Britain, they were glad to find such steps were being taken. Canada, he did not suppose for a moment, would suffer from such a course. The only emulation in that direction on the part of Canada, Australia, South Africa, and all the other portions of the Empire would be, he hoped, that each would do its utmost for its own particular state, province, or district, and he hoped the measures thus taken would be for the greatest benefit to all the other portions of the Empire. There was no necessity to speak of the loyalty of all the outlying portions of the Empire to the Mother Country; they were all true to the land from which they came, and would continue so, he believed, in the years to come.

Viscount RIDLEY wished to join in the thanks which had been expressed to the author for his interesting paper. Without any desire to import party controversies into the discussion, he wished to make an observation upon some of the earlier portions of the paper in which the author assumed that the verdict which the country had recently given upon an aspect of Imperial federation was final. He wished to assure Mr. Beale that there was a very large section of the country which did not regard that verdict as final, and did not mean it to be final. The Chairman had observed that it might be of great advantage to the Empire if a continued policy of Imperial immigration had been thoroughly considered and carried out from the beginning. He did not wish to say that that was no so, but desired to state that the Empire had developed on the principle of each colony looking as much as possible after its own affairs, as it became able to do so. If, in the early days, a definite principle of Imperial immigration had been established, the scheme must have been organised and directed from headquarters. It might, possibly, not have suited the

general character of the Empire, or have ended in sending to the Colonies the particular class of immigrants which was desired; and it was at least possible that, if such a scheme had been advanced earlier in the history of the Empire, it might not have conduced to its prosperity. Self-government in its fullest form was being rapidly developed year by year. The number of hours which English statesmen had to spend in considering the work of self-governing colonies was not very large; and he thought the present time was probably the best opportunity statesmen at home and in the colonies could have for conferring together upon the general needs of the Empire, and for considering a scheme of Imperial immigration, which, if it had been earlier considered, might have been against those liberal principles of self-government which were now recognised as the mainspring of the Empire.

Lord BRASSEY, K.C.B., hailed with the greatest satisfaction the reading of the paper, because he thought it was one indication among many of a more liberal disposition on the part of Australia in respect of immigration from the Motherland. Immigrants following the callings of skilled artizans, and those engaged in various industries such as could only be followed in towns and cities, would, he thought, be the least welcomed by those who were following the same callings in Melbourne and smaller industrial towns in Victoria; but he believed there would be an unreserved welcome to immigrants who would go out to Victoria and other parts of Australia and take up land and cultivate it, dealing with it successfully in smaller areas than those which were allotted in days gone by to the great pastoralists of Australia. Men who were successful in farming small areas were required. When he was in Victoria, it was said in the Western district that it was generally found to be the best plan to break up the land into farms of 300 or 350 acres, and deal with it by the method of mixed farming. To make the scheme a success, men were required who were skilled in dealing with the soil, in attending cattle, and who possessed a small amount of capital. Extra capital, however, would be required, and that was the difficulty standing in the way. It was desirable that those who went out to Australia should have, at any rate, some capital of their own, and he thought that such men might add considerably to their resources if money was advanced to them by lending banks, supported both by people in the Motherland and in the Commonwealth. That was a mere matter of detail, but in principle he thought it would be a very good thing for everybody if some suitable lending agency could be created, which would assist competent men with small resources of their own by lending them extra capital in order to cultivate land in Australia.

The Hon. W. H. JAMES, K.C. (Agent-General for Western Australia), inquired how it was that so much was heard from public men and in the press of England with regard to the immigration policy of Australia. The English press and English public men did not worry about the emigration of Britishers to Germany, Spain, Italy, France, or America, but directed very great attention to the immigration policy of Australia. He appreciated their sympathy, underlying which was the thought that it was beneficial to the Empire itself that emigrants should be supplied for Australia and Canada. If that were not so, people in this country would not be so anxious as to the point to which the stream should be directed. Every one realised that the greatest foundation on which the Empire could be built was racial unity. Australians sometimes thought that the old country criticised a little too severely from the point of view of those who desired to see the Empire push ahead, but overlooked the fact that perhaps there might be some obligation resting upon the old country to help towards the attainment of the fuller peopling of the Empire itself. There was no law preventing immigration into Australia. People could go there on the same terms as they could go to America, South Africa, or Canada, by paying their own fares. No country as a whole assisted in the payment of the passage of immigrants, and that was the condition in Australia to-day, although Western Australia did extend such assistance to immigrants. The difficulties Australia had to contend against were two—firstly, the want of knowledge of Australia in the old country, a state of affairs which he hoped would soon be remedied; and, secondly, its distance and the cost of getting there. When it was borne in mind that, broadly speaking, the cost of the passage to Australia at the present time was the same as it was 60 or 70 years ago, it would be understood that Australia must not be blamed, but the steamship companies. He was one of those who thought if a merchant desired to sell goods he would not do so if he placed the highest possible price upon them. Business people, as a rule, reduced the price as low as possible in order to attract customers. This rule was overlooked by the steamship owners. If people who lived in the old country realised how important it was that emigrants should be directed to various parts of the Empire, far better results would ensue. If, for instance, the information which was given to the students in all the schools of the country about Australia was accurate, that alone would remove a great number of misconceptions in relation to the Commonwealth, and in that way a great deal could be done to overcome the difficulties which existed.

The Hon. J. G. JENKINS (Agent-General for South Australia) said that, as a recent arrival from Australia who had travelled to England, viâ Canada, he had a fairly good knowledge of the extensive territory in both those countries which was waiting for immigrants. From the little travelling he had done in England, he fully agreed with the remark that had been made that there was an opportunity for settlement in England; and since his arrival in

the country he had met one Canadian and one Australian who had established both their sons on farms in this country, thinking there was a glorious opportunity in the Motherland for an improvement in agriculture. He did not wish to make a comparison derogatory to either Canada or Australia; they each had millions of acres of fertile soil waiting for the husbandman's spade, and mines of untold wealth waiting for the miner's pick. There was an opportunity in those countries for millions of people in Great Britain and on the Continent to better their conditions by immigrating. He would not, for a moment, try to divert the stream of immigration from the fair fields of Canada to Australia, but would like to see a new stream started for the Commonwealth, gathering force year by year, until thousands of people who were now ill-conditioned in Europe were given an opportunity of making homes for themselves, and being a valuable adjunct to the British Empire. After all, every settler sent to Canada, South Africa, or Australia, was only adding strength to the great home country, but he would much prefer to see the Colonies peopled by British subjects than by people from the South of Europe.

Mr. T. Hart-Davies, M.P., said that he had visited both Australia and Canada several times, his first visit to the former colony being in 1851. Last year he sent a man out to Winnipeg at a cost of £8. The controller of the immigrants there took him in hand and sent him to a particular farm, where he would be employed for a short time until he was in a position to obtain land of his own, and become a successful farmer. There was an idea abroad that in Australia such an unskilled individual would not be welcomed, and he, therefore, would be glad to know whether, if a similar man was sent to Australia, there would be a reasonable chance of his getting on?

On the motion of the Chairman, a hearty vote of thanks was accorded to the author for his exceedingly interesting paper.

Mr. Beale, in reply, after thanking the members for the very hearty welcome they had accorded to him, said the first question asked was by the Chairman with regard to the attitude of the workpeople in Australia towards immigrants. It so happened that, although he was president of the chief employing institution of Australia, which embraced 2,000 firms and scores of thousands of workpeople in their own immediate employ, he also carried credentials from the Trades and Labour Council of Sydney, a unique honour, and strong recommendations from the ex-Prime Minister, John Christian Watson. Those credentials only certified that they believed he would tell the truth, and not deliberately say anything unfriendly. It was an extremely rare thing for the Trades and Labour Councils to grant credentials to anybody at all, but to grant them to anyone in his position was a very exceptional proceeding. He desired to make it clear that he did not speak with any authority from them, although they would recognise that what he said was at least truthful, from his point of view. In connection with the question asked, he would like to mention the case of a doctor who went to Christchurch, New Zealand, and did not receive at all a hearty welcome. The doctors there told him they would not meet him, that they did not want competition because there was a sufficiency of doctors already there. The doctor was a man with plenty of fight in him, so he took a big shop and painted an announcement all over the front that people could get advice and medicine for eighteen pence. He had no sympathy with such proceedings, but it was quite likely that a better understanding would have been arrived at if his medical brethren had received him at first, and discussed what was the best thing to do under the circumstances. It was perfectly true, in the same way, that the workers of Australia would not welcome such an excess of immigration as would bring down the status of living, and the employers would not welcome it either. The doctors had a most perfect right to protect themselves, as any other trades union had; but, as had been truly said by one of the speakers, a hearty welcome would be given to all agriculturists. Australian people did not look upon the production of wheat as the very loftiest avocation that a human being could take up; they thought there were other occupations of at least equal honour, and requiring at least as much skill, namely, the manufactories which were in or near the cities. He had the pleasure of knowing a good deal about Germany, and he was very much rejoiced to see there that, whereas formerly in the small villages there were no factories at all, factories were now being established. It was necessary in the same way to spread and diversify occupation in Australia, so that those coming there would not reduce the status of living, but rather tend to raise it. People were constantly emigrating to the United States, yet there was no reduction in the status of living, but, on the other hand, a tendency to raise it. He hoped he had made it quite clear that the workers of Australia were not antagonistic to anybody. They would take by the hand, as heartily as the employers would do, anybody who went there to help forward the whole Australian nation, and thereby the British Empire, which embraced nations. While he was in the United States, he had the honour to attend by invitation a Conference which was held in Madison-square, New York, upon immigration, which was called for the purpose of guiding the Federal Government of the United States with regard to the legislative measures that should be adopted. Representatives were appointed by forty-one States to attend the Conference, in addition to representatives of the Universities and Trades and Labour Unions, altogether between 500 and 600 delegates attending. Mr. Andrew Carnegie, in addressing the Conference, ventured upon a line which was not at all accepted by saying there was no immigra-

tion problem at all, and that it did not matter whence the brain and brawn came so long as it came to America. The Conference, as a whole, did not hold that view, and thought that America ought to be as nearly as possible a white man's country. They did not welcome coloured workers. He thanked Lord Strathcona for his exceedingly kind remarks, and desired it to be thoroughly understood that the comparisons he (Mr. Beale) had made were with that portion of the British dominions which was most nearly like their own in respect of population. He had had the pleasure of meeting Sir Sandford Fleming, who was advocating a scheme, to which too little attention was drawn, in relation to telegraphic communication throughout the Empire, in which he suggested that the cables should be used for fraternal purposes of information when they were not otherwise employed. Mr. James had touched the marrow of the whole position when he spoke of the local provision that might very well be made in Great Britain for a number of unoccupied persons. He did not think it would be a successful policy to establish anything like an authoritative emigration commission to distribute emigrants to various parts of the Empire. It seemed to him a sorrowful thing that the men of high station and brilliant intellect that he saw around him, and such a philanthropist as General Booth, who would have been present but for another engagement, should have to devote their splendid thought and energy to the purpose of providing people with employment outside of their own country. He was certain he had the support of all the outlying parts of the Empire when he said they desired to see Great Britain prosperous too, and that somehow or other the unoccupied lands of the country should be re-occupied as they once were. His reply to the Chairman's question had really answered Mr. Hart-Davies's point in relation to unskilled labour. He did not think that a farmer was an unskilled man, and he certainly would be welcomed in Australia; but the Agents-General were best qualified to give an answer in what way he would be welcomed, by stating separately the inducements offered by the several States.

ELEVENTH ORDINARY MEETING.

Wednesday, February 14th, 1906; Colonel H. C. L. Holden, R.A., F.R.S., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

De Pass, Eliot Arthur, 23, Queen's-gate-terrace, S.W.

Dinwoodie, John Frederick, Madras Railway, Perambur, Madras, India.

Ghose, A., F.C.S., Messrs. Jambon et Cie, Ramandrug, *viâ* Sandur, India.

Goodman, Alfred, Araucaria, East Molesey, Surrey.

O'Brien, Captain Aubrey John, C.I.E., care of Messrs. H. S. King and Co., 9, Pall Mall, S.W.

Rapelli, Luis, Ferro Carril Central Norte, Tucuman, Argentine Republic, South America.

Sämy, Arthur Poonoo, 64, Queen's-road Central, Hong Kong, China.

Smith, R. Wilson, "The Chronicle" Office, Montreal, Canada.

Sparke, Walter, care of Messrs. Thomas Cook and Son, Rangoon, Burma.

Wetton, Miss Edith, 54, Church-street, Kensington, W.

Young, Lawrence Charles Hills, 10, Hamam-street, Bombay, India.

The following candidates were balloted for and duly elected members of the Society:—

Arsiwalla, Mehervanji Navrozji, 4, Pitha-street, Fort, Bombay, India.

Bomanji, Eruchshah Pestonji, Chowpaty Art Studio, near Willson College, Bombay, India.

Canziani, Enrico, 3, Palace-green, Kensington-palace-gardens, W.

Evans, M. Llewellyn, Stony Down, Sidcup.

Ford-Moore, Arthur Pilcher, A.M.I.C.E., M.I.M.E., 28, Warwick-road, Ealing, W.

Goff, Sir William G. D., Bart., D.L., Glenville, Waterford, Ireland.

Hodgetts, Charles Alfred, M.D., L.R.C.P., Provincial Board of Health, Toronto, Ontario, Canada.

Mookerjee, S. C., Imperial Druggists Hall, Umballa, India.

Polson, Franklin Bates, Polson Iron Works, Limited, Toronto, Canada.

Pullar, Rufus D., F.C.S., Brahan, Perth, N.B.

Raghavyya, B. C., B.A., High Court Vakil, Chittur, N. Arcot, India.

Stapledon, William C., 2, Marine-park, West Kirby, Cheshire.

Vicarey, R. W., Pen-y-cwm, Blackhill, Clun, R.S.O., Salop.

Walsh, Thomas Crosbie, Casilla 95, Antofagasta, Chili, South America.

Webb, Bernard Hugh, 2, South-square, Gray's-inn, W.C.

Wells, Miss Theodosia Mary, Grosvenor-crescent Club, Hyde-park Corner, W.

Whitaker, Mrs. William, 26, Curzon-street, W.

Witherspoon, Henry R., 43, Eyot-gardens, Hammersmith, W.

The paper read was—

THE HORSELESS CARRIAGE—1885-1905.*

By Claude Johnson.

It will be seen from the title that this paper does not pretend to record particulars of the very interesting steam vehicles which ran successfully on the roads of this Kingdom in the third decade of the last century, but which were driven off the road by opposition which arose from financial interests which they threatened, from ignorance and from prejudice.

We are confining ourselves to-night to the history of what may be called the "petrol" movement, and probably it will be agreed that no more moving subject could be selected than that of the revolution of the roads which has been effected during the last few years. An endeavour is to be made to tell in three-quarters of an hour the story of the first twenty years of this remarkable revolution.

It is interesting to remember that six years ago many people in this country had seen no methods of high-road locomotion other than those which were probably employed very shortly after Noah left the Ark except, of course, the bicycle, which, after all, is only another method of animal propulsion.

The motor-car has altered this state of affairs, and is altering it more and more every day.

Whether these alterations be for good or for evil we are not here to discuss, but it is useful to remember that the movement the history of which we are about to study is the sudden introduction of mechanical road locomotion which is day by day being adopted as a substitute for the animal road locomotion which had served our forefathers so faithfully and, as they thought, so adequately since the foundation of our race.

The memory of this fact of itself makes the subject-matter of this evening one of thrilling interest. But the genius and foresight of the fathers of motorism, the enthusiastic and sweeping methods of their apostles, the passionate and fiery onslaught of their opposers, the rapid development, and, in an astonishing short period, the triumphant victory of the new comer, go to make a history to which it would be difficult to find a parallel.

The history must always have a tinge of sadness for a British subject, because while Britain led the world in motorism in 1830 to 1840 or thereabouts, she was deprived of the lead by her own folly, and when France came to the fore in this important movement, which was encouraged in every way by her Government and people, British invention and enterprise were throttled by the insane and criminal legislation which, until the end of 1896, forbade the use of mechanical vehicles on the road unless they were preceded by a man carrying a red flag.

The writer wishes, at the outset, to make two facts clear. Firstly, that he is a member of the automobile trade, a circumstance which may be thought to account for some of the enthusiasm which he feels concerning the motor movement; and secondly that he is indebted to one to whom the movement owes a fund of gratitude for his energetic but tactful representation in the House of Commons of the desires and aims of the automobile party—namely, Lord Montagu of Beaulieu (John Scott Montagu). Lord Montagu has kindly permitted the writer to make liberal use of the series of articles entitled "Ten Years of Automobilism," which were contributed to his lordship's periodical *The Car Magazine*, and which are shortly to be published in book form.

The Fathers of the Petrol Movement.

In the year 1831, a Select Committee of the House of Commons had reported their belief that "the substitution of inanimate for animal power in draught on common roads, is one of the most important improvements in the means of internal communication ever introduced." Three years later, in 1835, there was born at Schorndorf, in Würtemberg, one who was destined to discover and demonstrate an inanimate form of road locomotion, which is now revolutionising internal communication throughout Western Europe, and which bids fair to do so throughout the world.

This genius, by name Gottlieb Daimler, was born of parents who were simple work-people. His passion for mechanics was such, that he studied them from his youth upwards, and, having gained practical experience in a gun-factory in Alsace, and a steam-locomotives works in Manchester, he became assistant to Dr. Otto, who was then endeavouring to devise a satisfactory gas engine. It was after

* This paper is not illustrated, as most of the cars referred to were illustrated in the Cantor Lectures, "Mechanical Road Carriages," by W. Worby Beaumont, M.Inst.C.E. See *Journal of the Society of Arts*, No. 2,249, 27 Dec., 1895; No. 2,250, 3 Jan., 1896; No. 2,251, 10 Jan., 1896; also Beaumont's Cantor Lectures on "Mechanical Road Vehicles," Nos. 2,656, Oct. 16; 2,657, Oct. 23; 2,658, Oct. 30; 2,659, Nov. 6, 1903. Further, this paper does not attempt to give any technical information since Mr. Beaumont's papers have dealt with the design and construction of cars, and the writer of the paper is not qualified to attempt anything of the kind.

Daimler had joined Otto, that the latter produced the now famous "Otto" gas engine, although it is not claimed that Daimler took part in the invention of it. Here Daimler met Otto's French agent, M. Sarazin, who later, took an important part in the foundation of the petrol movement in France.

Daimler became managing director in 1872 of the "Gas-Motoren-Fabrik," at Deutz, which was financed by a privy councillor named Langen, but he held the position for only ten years, as the manufacture of an engine interested him but little as compared with the creation of a novelty. In 1882, therefore, he closetted himself in premises at Cannstatt, and studied the production of a light, high-speed gas engine. In 1883, he patented an air-cooled horizontal gas engine, and in 1885 he took out a patent for an engine governed on the exhaust, and later for a vertical engine with water-cooling and a surface carburettor.*

This brings us to 1885, with which year this paper is supposed to commence. In this year Daimler produced a petrol-driven motor-bicycle with an engine giving half a horse-power, and before the end of 1886 he had built a motor *char-a-banc*, and had taken eleven persons for a voyage on the lake in the park at Cannstatt in a petrol-driven launch. The celebrated 2-cylinder "V" type Daimler engine (which was the type of motor first used in motor-cars) was not exhibited until it was shown in a motor-boat at the Paris Exhibition of 1889.

Unfortunately in 1900 Daimler died of heart complaint in his 65th year, but before his death he had achieved his ambition of constructing successful motor-carriages and motor-boats.

Whilst Daimler had been working at Cannstatt, Carl Benz, at Mannheim, had, in 1885, created a petrol motor-tricycle fitted with an engine having a horizontal water-cooled cylinder. In 1886 Benz took out a patent for a radiator for cooling the water system of his motor, and in the same year completed his second motor tricycle, which ran up to a speed of ten miles an hour. In 1888 he made his first small motor-car. It is interesting to note that Benz used electricity to ignite his charge, whereas this system was not adopted by the French makers until very much later.

It may well be asked what British inventors were doing at this period, seeing that two German engineers had produced successful motor-cars. It is a pleasure, therefore, to record that at the Inventions' Exhibition held at South Kensington in 1885, Edward Butler showed a motor-bicycle driven by a petrol engine, but unfortunately for the British industry, he was discouraged from carrying his invention further, owing to being forbidden to use his motor-cycle on the road.

Seeing that the first petrol vehicles of Daimler, Benz, and Butler were all produced in the year 1885, it will probably be agreed that this is the correct year to take as the beginning of the history of the petrol movement.

Successful as were the little Benz belt-driven cars, it will probably be admitted that the true forerunner of the modern automobile was the combination of the Daimler engine and the Levassor transmission. The history of the connection between the two is of considerable interest, and the writer is indebted to Colonel Holden (who has so kindly consented to occupy the chair to-night) for a letter of introduction which enabled him to obtain valuable details concerning it.

M. Sarazin who, it will be recollected, was the agent of Otto for France as far back as the year 1877, journeyed in 1886 to France, having the French rights of Daimler's patents in his pocket, and arranged for the manufacture of the Daimler engine at the factory of Perrin, Panhard, and Company, who were manufacturers of woodwork machinery. The work of building these engines was entrusted to a member of the firm, M. Levassor.

Shortly after this M. Sarazin died, and his widow found it necessary to seek the assistance of someone having a knowledge of the patents to carry out transactions with Daimler with reference to the French patents. She therefore asked M. Levassor to accompany her to Cannstatt. On their return from Germany, M. Levassor and the widow Sarazin, became engaged to be married, and the French rights for the Daimler patents formed one of the valuable possessions which he took to his heart, with his wife.

In December, 1889, the first Daimler motor was completed at the Panhard Works, and so impressed was Levassor at the Daimler petrol boat and petrol quadricycle, which were shown in Paris at the Exhibition of 1889, that he set to work to design a complete horseless carriage.

It should never be forgotten that, although Daimler produced a motor and a belt-driven car, Levassor produced the sliding change

* Col. Holden points out that Daimler invented tube ignition.

speed gear, the clutch, and, in fact, the car, which in principle is the car of to-day. It may seem a simple problem; given an engine to make a motor-car, but Levassor found it otherwise. Fortunately, he was an enthusiast, and after repeated failure was not disheartened. He was confident that a motor vehicle, arranged according to his designs, could be made to go, and he made up his mind that he would make his vehicle go. Time after time he started to perform a journey which he had set his heart upon completing, viz., from the Avenue d'Ivry to the Point du Jour and back without a stop, a distance of about six miles. Each attempt revealed some little difficulty requiring to be remedied. The first journeys were short. Little by little they became longer. Towards the end of 1892, viz., eighteen months after he commenced to build his vehicle, he had the satisfaction of running six miles without a stop. This indeed was the most glorious non-stop run which the world will ever see.

Levassor's vehicle was quite original. Daimler and Benz had used the belt-drive with the motor behind. Levassor invented the following characteristics:—(1) He placed a vertical motor in front of the car inside a bonnet; (2) he had a clutch in the fly-wheel; (3) he had a change of speed by cog-wheels in various ratios; (4) a counter-shaft bearing the differential and chain sprockets; (5) the whole mounted on a wooden chassis which rested on axles provided with springs.

Peugeot* at the same time that Levassor was working on his car had purchased Daimler engines from Panhards, and had built a car on which it is said that he ran 1,000 miles in the year 1891. The gears on the early Peugeot were designed to give 3, 6, 9, and 12 miles per hour respectively. But whereas Peugeot may have been as successful as Levassor in making a car to run, he did not, as Levassor did, invent the modern car. He had an engine behind, and a general arrangement which is abandoned in modern vehicles, whereas Levassor's car contained, roughly speaking, the general arrangement which has been adopted by nearly all modern makers.

* Les Fils de Peugeot Frères fitted their cars with 2 cylinder V Daimler motors, built by Panhard et Levassor, and geared their cars to ascend inclines of 1 in 12 to 1 in 10 at from 2 5 to 3 1 miles per hour, and to attain a speed of 9·3 to 11·2 miles per hour on a level dry road. The wheels of the Peugeot cars were fitted with pneumatic tyres. The extreme length of these cars was from 8·4 to 8·8 feet, and the price from £248 to £2[illegible].—Extracted from the *Engineer*, July 20, 1894. See also *Engineer*, July 27, 1894, p. 86.

It is certain that many of those in this room will share with the writer the regret that they had not the honour of knowing this truly remarkable man, for Levassor was not only a designer, draughtsman, engineer, technical and business director and organiser, but he proved himself to be a fine enthusiastic sportsman by driving one of his cars in the Paris-Rouen Race in 1894, and in 1895 drove from Paris to Bordeaux and back, a distance of 732 miles in 48 hours 48 minutes. On this occasion he remained on his car altogether for about 53 hours, and during nearly 49 of those hours he was steering it. Levassor died quite suddenly at his work in 1897.

No automobile club can be complete without pictures or statues of the Fathers of Automobilism, or at least some fitting memorial to remind members of the debt which not only motorists but the world at large owe to the men who first produced the modern motor-car.

The Apostles of the Fathers.

The fact that Daimler, Levassor, and Benz had successfully driven mechanical vehicles upon the road appealed naturally to a journalist who had identified himself in a very marked manner with the early days of the cycle movement, viz., M. Pierre Giffard. This enterprising Frenchman early in 1894 undertook the organisation on behalf of *Le Petit Journal* (the father of halfpenny newspapers) a trial of mechanical vehicles.

It is astounding to think that, at a time when many people in this country had only just recovered from the shock of learning to propel themselves on bicycles, this far-seeing Frenchman, backed by the very capable proprietors of *Le Petit Journal*, foresaw that we were to abandon the horse in favour of motors, and had resolved to give the first demonstration of the new vehicle.

Handsome prizes were offered by *Le Petit Journal**, routes were selected, judges were appointed to report on the speed, safety,

* It was in December, 1893, that *Le Petit Journal* first proposed a series of trials of motor vehicles. It was explained that there would be no attempt at racing on the high roads. Each vehicle was to be submitted first of all to a preliminary run in which it was to cover 31 miles in four hours—a speed of $7\frac{3}{4}$ miles per hour being considered quite sufficient for ordinary use. The entry fee was 8s. 4d. A police regulation dated 14th August, 1893, applying to all the Department of the Seine prohibited any self-moving vehicle from travelling along the public roads in towns at a speed exceeding 7·44 miles per hour (12 kiloms) or at a speed exceeding 12·4 miles per hour (20 kiloms) in the open country. There were 102 entries from 93 different persons or firms of which only one was from England and two were from Germany.

comfort, and ease of control of the vehicles, and it was arranged that the trials should end with the now historical Paris to Rouen race, which was run in July, 1894.

In these early days there were still those who clung (as some indeed cling still) to the belief that steam could do as much, as if not more, than petrol. As a matter of fact, the first car to arrive at Rouen was a De Dion Bouton steam tractor having an ordinary carriage attached to it. Yet to-day, within a few yards of this door, there are running motor-omnibuses, bearing the far-famed name of De Dion Bouton, which are driven not by steam but by petrol motors. This fact seems to justify the use of the term "petrol movement," in connection with the revival of motor road locomotion.

The speed made by the steam-car over the 79½ miles between Paris and Rouen was, on an average, 12 miles an hour. Five minutes after the arrival of the steamer a Peugeot carriage fitted with a 3½ h.p. Daimler-Panhard engine arrived, then a second Peugeot carriage, and later a Panhard carriage. The Peugeot cars were fitted with wire-spoked wheels and india-rubber tyres. The Panhard car had wooden wheels and iron tyres.

From the account published in *Le Petit Journal* it is interesting to note that the French people were eager to welcome the new vehicles. Towns were decorated, Cabinet Ministers went to witness the start; the newspapers generally supported this very interesting experiment; schoolmasters and nuns brought their pupils out to witness this historical event; and those who, like Mr. Gordon-Bennet, of the *New York Herald*, witnessed it, must be almost as proud as those who, like the present Marquis de Dion, took part in it.

The Panhard and Peugeot cars were given the first prize, the De Dion steamer the second, and a Serpollet steam car was given third prize; and Mr. Gerrard, who entered an electrical vehicle which had frequently been used on the streets of Birmingham, was only prevented from running by the fact that the car was detained by the Customs for eight days.

This trial of 1894 made a great impression on the minds of some of the most intelligent Frenchmen, and the result of it was that on the 18th November, in the same year, a meeting was held at the house of the Comte (now the Marquis) de Dion. It was attended by many well-known men, including the Baron de Zuylen, and it was decided that in 1895 there should be a race from Paris to Bordeaux and back, and that any stoppages on the road should be counted as part of the running time of the vehicles. A subscription list was started, which eventually realised £4,000. It is the subscribers to this fund who may properly be numbered among the true apostles of the Motor Fathers.

Before passing to the year 1895, however, it it necessary to complete this short sketch of the year 1894, by stating by the end of the year Panhard and Levassor had produced no less than ninety motor-cars, and Peugeot had purchased from Panhard, eighty motors. In this country, Mr. Harry Hewetson, in August, 1894, gave an order to Benz and Co., of Mannheim, for one of their cars, which he received in England in November of that year, and this is believed to be the first petrol car which was introduced into this kingdom.

1895.
Paris-Bordeaux-Paris Race.*

This race started on the 11th June, 1895. The vehicles assembled at the Arc de Triomphe, and went in procession to Versailles.

The first car was started thence at 12.15 midday. After what has been already stated in this paper concerning the remarkable journey of M. Levassor, it will not be surprising to learn that his was the first car to arrive back at Paris. However, the first prize was given to a Peugeot car, which arrived very shortly afterwards, as the Peugeot was carrying four passengers, whereas M. Levassor's car carried only two.

Sixteen petrol and seven steam vehicles started from Paris; eight petrol and one steam car arrived back in Paris. The race may therefore be said to have been a veritable triumph for the petrol car. The solitary steam car which competed the race was that belonging to M. Bollée. It is notable that the first five cars to arrive at the finish were all fitted with Daimler motors.

The Marquis of Chasseloup Laubat, in an article in the *North American Review* of September, 1899, gave very interesting particulars of this race. A large proportion of the description is reproduced in the Badminton Library Book on Motors. Mention is made of this description, as it is not proposed to produce full particulars of the race in this paper owing to the necessity of briefness.

* A good report on the Paris-Bordeaux-Paris race appeared in the *Engineer* of June 21, 1895, p. 527.

To turn to the condition of motor matters in this country in 1895, it may be mentioned that Mr. Hewetson drove the Benz car, which was referred to, from Liverpool-street to Charing-cross in the middle of a day early in 1895. The public and police were so surprised at the sight of a horseless vehicle that he was not interfered with until he arrived at Charing-cross, where a daring police-constable insisted upon his stopping the vehicle, and took his name and address. Mr. Hewetson then visited Scotland-yard, and was warned that he must not repeat the offence.

During 1895, however, Mr. Hewetson drove this car many miles in Ireland, where the authorities were somewhat more complacent than those in London. But although little had been seen of automobiles in this kingdom, Mr. Shaw Lefevre, the President of the Local Government Board, prepared a new Locomotives Act, which unfortunately was not proceeded with in consequence of the defeat of the Ministry.

On Tuesday, October 15th, in the same year, however, Sir David Salomons, who had been studying automobilism in France, and who happened to be the Mayor of Tunbridge Wells at that time, held an exhibition of motor vehicles in connection with the Tunbridge Wells Agricultural Show, and on a somewhat rough and soft grass track before many thousands of spectators a $3\frac{3}{4}$ h.p. Peugeot, fitted with a Daimler engine made by Panhard and Levassor, a Panhard Levassor carriage (which was introduced into England by its owner, the Hon. Evelyn Ellis, in June, 1895), a De Dion tractor attached to a landaulet, and a De Dion Bouton motor tricycle, with petrol engine and electric ignition, were demonstrated.

It is somewhat remarkable to note that in the newspaper accounts of this exhibition, the main objections taken to the automobiles were the vibration of the carriage when the wheels were at rest and the smell of the petroleum spirit. It was regarded as a remarkable achievement by the onlookers that the cars of Sir David Salomons and the Hon. Evelyn Ellis mounted a hill in the showground which had a gradient of about one in forty.

Other cars which were being run on the roads of this kingdom in 1895 were a small petrol vehicle which had been made by Mr. John Henry Knight of Farnham, and a Lutzmann car which was driven in the neighbourhood of the Solent by Mr. J. A. Koosen, while in December of this year Mr. T. R. B. Elliott received from Paris the first petrol car introduced into Scotland.

Mr. Knight's little car was run by him about 150 miles on the public roads during 1895 before its performance was put a stop to by the Surrey County Council.

Following on Sir David Salomons' valuable educational exhibition in October, 1895, he wrote to the *Daily Telegraph* suggesting the formation of an Association to deal with self-propelled locomotion, and asked that those who wished to join the association should write to him, and that envelopes should be marked "Automobile." Subsequently between 300 and 400 people attended a meeting held at the Cannon-street Hotel on December 10th, 1895, when Sir David, having pointed out the necessity for an immediate alteration of the law, a resolution agreeing to the formation of the Self-Propelled Traffic Association was passed.

The motor world has to thank Sir David Salomons for the energy, labour, and money given by him ungrudgingly to the cause at this important period in its history. He was continually travelling between London and the Continent with a view to keeping himself informed of all that was passing in the motor world on the Continent. He suggested the form of a new Act of Parliament. He arranged a deputation to Mr. Chaplin, the then President of the Local Government Board, and this was followed by petitions to the same official; and it must be said of Mr. Chaplin with gratitude, that he showed a hearty sympathy towards the proposals, although he had so long and so intimately been connected with agriculture.

November, 1895, saw the foundation of the first automobile paper in this country, which owes its birth and title, *The Autocar*, to the initiative of Mr. Henry Sturmey.

The same year witnessed the appointment of the first committee of the Automobile Club of France, and the foundation of the Belgian Automobile Club.

A fact which must be recollected by many of those present, and one which must be interesting to any members of the Society of Arts, is that Mr. Worby Beaumont having made a careful study of automobilism from its outset, recorded his observations in a very interesting series of papers which were read before this Society towards the end of 1895. Professor Vernon Boys, F.R.S., in connection with these Cantor Lectures, wrote a very interesting and somewhat prophetic letter, which foretold the general adoption of pneumatic tyres, and that

the motor would go a long way towards solving the traffic problem, and improving the sanitation of big cities.

On December 12th, 1895, at the Palais de l'Industrie, in Paris, an Automobile Exhibition was held, which showed that the automobile industry in France, even at that early date, was thought to be worthy of a special exhibition of its own.

No record of the year 1895 would be complete unless it mentioned that our chairman of to-night—Col. H. C. L. Holden, R.A., F.R.S.—invented, built, and used in that year a motor-propelled bicycle which contained very many interesting features. It embodied the following points which, since then, have been recognised as right, and have been adopted by many makers :—1. Four-cylinder engine. 2. Single coil synchronised ignition. 3. Mechanical lubrication. 4. Handle bar control. 5. Exhaust valve lifter.

1896.

As the law which permitted motors to be used on the roads of the United Kingdom was passed and came into operation in 1896, the year is one of considerable interest in the history of motorism in this country; but before dealing with affairs at home, it would be as well to very shortly review affairs abroad.

France, which for the last fourteen months had boasted the possession of a paper devoted to the cause of motoring, viz., *La Locomotion Automobile*, founded by M. Vuiellemot, considered the movement to be sufficiently healthy to start a second paper, and accordingly M. Paul Meyan, in February, 1896, produced *La France Automobile*.

In this year some of the big houses in Paris, such as the Grands Magazins du Louvre and "La Belle Jardinière," were using motor vehicles for delivery purposes.

The most important events of the year, so far as automobile history is concerned, were the opening of the premises of the Automobile Club of France in the Place de l'Opera, the Exhibition held at the Palais de l'Industrie in October, and the Paris-Marseilles Race in February.

The Paris-Marseilles Race.*

Unlike the Paris-Bordeaux Race of 1895, the Marseilles Race was divided into five stages on the outward journey and five stages on the return journey. The start took place on September 24th, 1896, from Versailles. In the crowd which filled the square in front of the Chateau there were forty English engineers, including Sir David Salomons, who drove his Peugeot car to see the start. Of the thirty-two vehicles which started twenty-four were propelled by petrol, three by steam, and five were petrol tricycles.

M. Bollée on his tandem tricycle astounded the world by completing the first stage at an average speed of 20 miles an hour, which was by far the best performance which had been done up to that time by a motor vehicle.

The weather was extremely bad on the second day, torrents of rain being driven by a very strong wind. At several points the route was blocked by fallen trees. At the end of the day a Panhard and a Peugeot were to the front. On the third day the Panhard was still to the front. On the fourth day M. Levassor's car collided with a tree owing to his making a swerve to avoid running over a dog. He was so much shaken by the accident that he had to abandon the race, and it is said that he never thoroughly recovered from this accident.

The Peugeot carriage arrived first at Avignon at the end of the fourth day, and on the fifth thirteen vehicles reached Marseilles, the first to arrive being a Panhard car, which, with a strong wind behind, covered the last stage of $67\frac{3}{4}$ miles in three hours six minutes. The De Dion tricycles had been closely in the rear of the leading cars throughout the journey to Marseilles, and on the first stage of the return journey one of these tricycles arrived first at Avignon.

Two Panhard cars arrived first at Lyons and Dijon. From the latter place the racing cars were followed by the Hon. Evelyn Ellis and Mr. Paris Singer.

By eleven o'clock on Saturday morning a large crowd had gathered at Porte Maillot to witness the finish of the race. The result was as follows :—

Distance, 1,076 *miles.*

	H.	M.	S.
Panhard and Levassor (No. 6 M. Mayard)	67	42	58
Panhard and Levassor (De Knyff)	68	11	5
Dion tricycle	71	1	0
Panhard and Levassor (No. 5 Levassor)	71	23	22
Dion tricycle (entered by Michelin)	73	30	12
Peugeot..	75	26	24
Delahaye	75	29	48
Peugeot	81	23	51
Dion tricycle	83	6	16
Delahaye	84	27	5
Maison Parisienne	100	41	37
Maison Parisienne	108	39	48
Landry and Beyroux	137	11	17

* For full report of Paris-Marseilles-Paris race, see *Engineer* of Oct. 2, 1896, p. 333, and Oct. 9, 1896, p. 355.

The speed of the winner was about 15·6 miles an hour. The speed of the De Dion tricycles averaged 14·7 and 13 miles per hour respectively. The winning Panhard car was the first car fitted with a 4-cylinder engine. It was driven by M. Mayard, and was afterwards purchased by the Hon. C. S. Rolls.

The second car, which was driven by Chevalier de Knyff, was subsequently bought by Mr. S. F. Edge, and was later fitted with the first Napier engine ever made, and Mr. Charles Jarrott bought the car which was driven by M. Levassor in this race.

There can be no doubt that these gentlemen by introducing the best cars of the time into England, stimulated home designers and constructors to produce up-to-date cars.

To turn to automobilism in England, in 1896, we have to review a very remarkable year, as it was during this year that the Light Locomotives Act, which legalised the use of motor vehicles, was passed, that the famous run from London to Brighton took place, and that company promoters were very active in floating motor companies.

The attitude of the public may be best shown by a few extracts from the Press. The *Lancet* in its issue of the 4th January, 1896, made the following bold declaration :—

"We believe that the motor-carriage in some of its forms will prove admirably suited for the requirements of medical men, and it will not be long in coming into extensive use."

The *Daily Telegraph* was cautious in stating :—

"That London society will pay its guineas and go to dinners, dances, or the theatre in a private horseless carriage is, perhaps, not a state of things which is yet within measureable distance."

And a "Lover of Horses" wrote to the *Yorkshire Post* concerning the great harm that the motor would do to the farmers in the breeding of horses, and added :—

"Not only is the demand for horses concerned, but the provender that is required, grown so largely by farmers in this country. I am told that autocars are becoming a great nuisance in France where many accidents have happened. Private owners of horses are disposing of them rather than run the risk of meeting the carriages on the roads. I think immediate steps should be taken by all agricultural societies, farmers, landowners, and others interested, to petition Parliament against this hurtful measure."

The following ingenious reply appeared, signed by a Major Warren :—

"Far from injuring the farmers, the introduction of the horseless carriages will benefit them enormously by still furthering lowering the demand for corn, which will compel farmers to turn their attention to raising poultry, vegetables, butter, and other perishable articles, for all of which there is a ready market in England, if only the railway freights were reduced to their proper level, and the introduction of horseless carriages and light railways will soon bring down these exorbitant rates."

The writer in the *Sunday Times* evidently had the gift of prophecy highly developed when he wrote :—

"Lord Harris, having piloted the Locomotive on Highways Bill through its second reading in the House of Lords without opposition, it will not be long before the autocar becomes a familiar object in the streets. It is rumoured that the London General Omnibus Company intend to substitute autocars for the present vehicles as soon as may be practicable, and the big drapers houses and universal providers must save a very considerable amount in horseflesh if they follow suit. The Paris houses are already employing autocars. I can only foresee one possible danger in the autocar. The evil propensity of the Thames launch to steam down in mid-stream regardless of everything in its way is well known. Autocar owners will have to watch lest they also make too arrogant a claim to the middle of the road."

Let us now review the steps which were taken by ardent automobilists to bring about the passing of this famous Act. Following the example of the *Engineer*, the *Autocar*, early in January, 1896, inaugurated a petition to the House of Commons, asking that the House would pass a Bill which would permit motor-cars to run on the roads. The cities of Birmingham, Coventry, and Exeter were amongst the first municipal authorities to sign similar petitions. The Self-Propelled Traffic Association sent a deputation, under the leadership of Sir David Salomons, to Mr. Henry Chaplin, President of the Local Government Board, in February, 1896, and in March Lord Harris introduced a measure into the House of Lords, and secured the second reading of it at the end of April. It should be recorded that at this time the Self-Propelled Traffic Association had as its President, Sir David Salomons, and Sir Frederick Bramwell, Mr. John Philipson, and Mr. Alexander Siemens as Vice-Presidents, and amongst the members of the Council were Mr. Shaw Lefevre, Sir Albert K. Rollit, Professor Vernon Boys, Mr. Worby Beaumont, Mr. John Henry Knight &c.

The Association memorialised the Chamber of Commerce with reference to the maximum weight of motor vehicles. The result of the energetic steps taken by the Association was that on the 30th June, 1899, Mr. Chaplin

moved the second reading of the Light Locomotive Bill in the House of Commons. His remark that it was even possible that these motor cars might become a rival of light railways was received with laughter. Mr. Martin and Mr. Mundella on this occasion spoke in favour of the Bill.

The next step was a public demonstration of motor-cars. This was arranged by the Motor Car Club, which had been formed by Frederick R. Simms. In the summer of 1896 an exhibition of motor-cars was held at the Imperial Institute, and at a special reception to members of the House of Lords and the House of Commons, Mr. Evelyn Ellis had the honour of driving the then Prince of Wales (now His Majesty the King) on his Panhard car in the galleries and gardens of the Institute, and the members of the Legislature were given similar drives.

At the exhibition of motor vehicles, which was held during the summer at the Imperial Institute, in addition to Mr. Evelyn Ellis' Panhard, Mr. Koosen's Lutzmann and other cars, Mr. Leon Bollée was showing his petroleum tricycle on which he had previously driven some 500 miles.

In the same year an exhibition of motor vehicles was opened at the Crystal Palace by the Lord Mayor, at which Sir David Salomons, Mr. T. R. B. Elliott, Mr. John Henry Knight, and others demonstrated their cars by running them in the grounds of the Palace.

It was also in 1896 that the Daimler Motor Company, Limited, was formed with a capital of £100,000, and immediately after the opening of the exhibition at the Imperial Institute, the Great Horseless Carriage Company was launched with a capital of £750,000. The prospectus modestly announced that the company was "formed to establish the great horseless carriage industry in this country. Extensive works with railway and canal adjoining had been secured which were capable of an output more than equal to the entire capital of this company in value *every year*."

Company promoters realised that the coming of the motor car was likely to excite the imagination of a certain class of investor or speculator, and motor patents, good, bad, and indifferent, were acquired and offered to the public by means of companies with outrageously inflated capitals. The total capital of motor companies floated in ten months in 1896 was £2,300,000. It is significant that out of £500,000 worth of shares which the British Motor Syndicate received in connection with the floating of the Great Horseless Carriage Company in May of 1896, only £31,000 stood in the name of the syndicate in the month of August of the same year.

The so-called Motor Car Club was, it appears, subsidised to the extent of £6,000 by the British Motor Syndicate, and this club on November 14th, the date on which the new Light Road Locomotives Act came into operation, organised a run of motor cars from London to Brighton. The start of this run drew one of the largest crowds which had been seen for years in London. Herr Gotlieb Daimler was amongst the guests at the preliminary luncheon.

The Panhard cars, which had won the Paris-Bordeaux race of 1895 and the Marseilles race of 1896, three Bollée tandem tricycles, a German Daimler barouche, a German Daimler omnibus, Victoria, wagonette and parcels van, two Duryea motor cars, three Roger (Benz) vehicles, an Arnold dog-cart, and a Pennington 4-seated motor cycle took part in the start.

The two Bollées were the first vehicles to arrive at Brighton, a Duryea was the third, and a Panhard fourth. Although this celebrated run was organised under company promoting auspices, it will always be remembered as an important event in the history of British automobilism, inasmuch as it celebrated the revival of automobilism in this kingdom.

Automobilism in Scotland cannot be said to have been in a flourishing condition in 1896. It is believed that Mr. T. R. B. Elliott was the only owner of a car in that country during the year, and through the courtesy of the chief constable of Roxburghshire he was allowed to use the car in that county prior to the passing of the Act, and covered very many miles during the year. On venturing into Berwickshire, however, he was summoned and fined sixpence, inasmuch as he had not a man preceding him on foot carrying a flag.

Mr. John Brown, F.R.S., an eminent scientist of Longhurst, near Belfast, was, it is believed, the first owner of a motor-carriage in Ireland. He purchased a Serpollet car, which arrived from France at his residence on 6th March, 1896. This steam car was fired by coke, and it took two or three hours to get the boiler warmed up, but when this was once done the car ran well.

1897.

In spite of the useful work which was being carried out by the Self-Propelled Traffic Asso-

ciation and its Liverpool branch, controlled respectively by Sir David Salomons and Sir (then Mr.) Alfred Jones, Mr. Frederick Simms, with Mr. Harrington Moore as his lieutenant, having abandoned the Motor Car Club, decided to form an Automobile Club for the United Kingdom, and owing to Mr. Simms's liberal financial support and Mr. Moore's energetic organisation, this club was successfully launched at No. 4, Whitehall-court, on December 8th, 1897, Mr. Roger Wallace, K.C., having accepted the chairmanship.

Perhaps the most important event in 1897, however, was the competition inaugurated by the *Engineer*, in connection with which 1,100 guineas were offered in prizes. Although twenty-eight vehicles were entered in the 4-seated passenger vehicle class, nineteen in the 2-seated passenger vehicle class, fifteen in the 1-ton goods-van class, two in the parcels-van class, and eight for the paraffin fuel vehicle prize, it is evident that the designers and constructors of many of them did not find it as easy as they had anticipated to construct a motor vehicle; for when the competition was opened it was found that although the prizes had been announced nearly two years previously, the sole representatives of British automobilsm were a "Lifu" steam-van, a Busbury electric dog-cart, Roots and Venables' 4-seated paraffin dog-cart, the same firm's paraffin tricycle, the Yeovil Motor Company's pretroleum-engined dog-cart, the Holroyd-Smith benzoline motor phaeton, Mr. Cornell's Benz, and the Electric Motive Power Company's victoria. It is difficult to imagine the blow which investors in motor companies received when the judges announced that they would not give any prizes, as they did not consider that any of the vehicles submitted were sufficiently good to come up to the standard of excellence required.

Those of the public who had invested their money in companies which were to sweep horse-drawn carriages off the roads of our cities, were to provide electric bath chairs for invalids, and were to substitute electric omnibuses for horse-drawn omnibuses, felt far from comfortable, and the *Engineer*, on the verge of tears, asked "After all, are motor-cars wanted? . . . There is no such thing as a thoroughly satisfactory self-propelled vehicle."

Probably part of the failure of the trials was due to the conditions laid down by the *Engineer* which required an almost perfect vehicle, and this could not be expected at this very early stage in motor construction.

It must not be forgotten that in 1897 a motor exhibition was held in London. Curiously enough, it formed part of a laundry exhibition, the fact being that its promoter, Mr. Charles Cordingley, was in the habit of holding a laundry exhibition, and foresaw that the addition of motors might enhance the attraction of his display of washing apparatus. It must be remembered, however, that in 1899 Mr. Cordingley promoted a very successful purely automobile exhibition which has been repeated yearly.

Generally speaking, so far as automobilism in the United Kingdom is concerned, 1897 must be looked upon as the year of depression following the excitement and elation (or may be say inflation) of 1896. In 1896 the British public thought that a motor milennium had arrived, and that each sovereign invested in motor undertakings would bring them scores of sovereigns in return. In 1897 the investor wished that he had his sovereign again in his pocket.

Before leaving the history of 1897, it should, however, be pointed out that there was one bright feature, and that was the remarkable journey made by Mr. Henry Sturmey on one of the first English-made Daimler motor cars. His journey proved to many thousands of Scots and Englishmen that the motor was reliable, and his Daimler car was the first car seen on many parts of the Lands End and John O'Groats road.

In order to save waste of energy, Mr. Sturmey had a card printed, a copy of which he handed to enquirers. Amongst other things, the card informed the enquirer that the car could not explode, it could travel at 14 miles an hour, its average speed was 10 or 11 miles an hour, it could be stopped in 10 feet when travelling at full speed, and it cost less than $\frac{3}{4}$d. per mile to run. As a matter of fact, Mr. Henry Sturmey covered 929 miles in $93\frac{1}{2}$ hours (running time).

In France, in 1897, a race of $144\frac{1}{2}$ miles was held in January, between Marseilles, Nice, and La Turbie. In this race there was a furious battle between the Comte de Chasseloup-Laubat on a steam car, and Mons. Lemaitre on a Panhard; Lemaitre had trouble with punctures, and Chasseloup-Laubat finished first in 7 hours 45 minutes, thus showing that steam was by no means dead.

The mention of pneumatic tyres reminds me of the fact that the first car to race on pneumatic tyres was a Panhard car entered by M. Michelin in the Paris-Bordeaux race of

1895, but solid rubber tyres were used on the winning cars of 1894, 1895, and 1896.

This is not the occasion on which to discuss the important part which pneumatic tyres have played in the development of the automobile, but the credit which is due to the MM. Michelin for their enterprise in connection with pneumatic tyres for motor cars must not be forgotten.

In August, 1897, trials of motor cars for heavy loads were held by the Automobile Club of France, which aroused very general interest, and were witnessed by Mr. Worby Beaumont, Sir David Salomons, Professor (now Sir) Boverton Redwood, and others.

Paris-Dieppe Race, 1897.*

The best race of the year was the Paris-Dieppe race which was held on July 24th. It was inaugurated by two Paris newspapers, viz., *Le Figaro* and *Les Sports*, in conjunction with the Automobile Club of France. The distance was 106 miles. The Self-Propelled Traffic Association was represented by Mr. Worby Beaumont, The Hon. C. S. Rolls, Mr. Stanley Spooner and Mr. Redwood. An interesting episode occurred in connection with this race. The Automobile Club of France hired a special train to carry its members who had witnessed the start, to Dieppe to witness the finish. As fortune would have it, however, the engine broke down; the consequence was that the members of the club arrived at Dieppe, after the leading cars had arrived there, and the railway company compensated the Automobile Club of France to the extent of 10,000 francs.

A three-wheeled Bollée was the first vehicle to arrive. Driven by M. Jamin, it made an average speed of 25·1 miles per hour; a De Dion steamer averaged 24·6; a 6 horse-power Panhard (the winner) 23·1, and a 1½ horse-power De Dion tricycle 22·2 miles per hour.

In August, 1897, in a race from Paris to Trouville (107 miles), M. Jamin, on a Bollée, made an average speed of 27·8 miles an hour.

Races in France.

Perhaps it may at this point be more convenient instead of dealing with automobilism year by year to relate the history of its various branches from 1898 onwards. Let us first follow the remarkable history of motor racing.

In July, 1898, the Paris-Amsterdam-Paris race took place, the distance of 943 miles being divided into six stages. Charron on a Panhard having four cylinders, made the extraordinary average of 26·8 miles per hour. The car which he drove was the first Panhard which was fitted with a radiator, and with worm, sector and wheel steering.

In the humble opinion of the writer no finer race has ever been run than the "Tour de France," which was organised by *Le Matin*, and took place in July, 1899. The distance was 1,379 miles divided into seven stages, varying from 119 to 237 miles per day. Half an hour was allowed at the end of each stage, and half an hour at the beginning of the next stage for replenishment and adjustment of the cars. The most remarkable records of speed were those of De Knyff, who averaged 37½ miles an hour for 120 miles, and an Amedée Bollée, which over a distance of 44 kilometres averaged 45½ miles an hour. This was the first occasion on which a Panhard was severely pressed by Levegh on a Mors. However, Panhards took first, second, third, and fourth places in this race. The writer well remembers in the same year seeing de Knyff drive a 16 horse-power Panhard in the Spa race. The way in which the car went up hill was electrifying to one who had only recently witnessed the best cars in England toiling up Petersham hill in the trials held thereon by the Automobile Club. In the Paris-Ostend race of the same year, Mr. John Scott Montagu (now Lord Montagu of Beaulieu) drove an English Daimler car in the Tourist class and took third place, and Mr. Rolls driving an 8-horse Panhard, took second place. It was in July, 1899, that Mr. Gordon-Bennett first suggested to the Automobile Club of France that he should give the cup, which eventually became known as the Gordon-Bennett Cup, and the first race for this cup was run on the 14th June, 1900, over a course of 341 miles, between Paris and Lyons. Belgium was represented by Jenatzy, America by a Winton car, which abandoned the race on arriving at Orleans 2 hours 37 minutes behind the leader. France won, owing to the performance of M. Charron on a Panhard, who made an average of 38·4 miles per hour. The most important race of 1900, however, was that between Paris and Toulouse (held in connection with the Paris Exhibition of that year), which was divided into three stages of 448, 218, and 230 miles respectively. Levegh on a 24 h.p. Mors won, having covered the 896 miles at an average of 33½ miles an hour. Panhard cars took second and third places.

* For report of Paris-Dieppe race, see *Engineer*, July 30 1897, p. 102.

Mr. Edge started in this race on a Napier car, but had to retire owing to ignition troubles. In May, 1901, France again won the Gordon Bennett race, which was run over a distance of 351 miles, between Paris and Bordeaux, the winner being Girardot on a 40 h-p. Panhard, the average speed being 40 miles an hour. Mr. Edge had arranged to drive a Napier car representing this country, but was unable to start owing to the British tyres failing him. The historic race of the year, however, was that between Paris and Berlin, a distance of 687 miles, divided into three stages. Henri Fournier, who had already won the Paris-Bordeaux race, won the Paris-Berlin race on a Mors car making an average of 44·1 miles an hour. This car was designed by M. Brazier, who later designed the successful Richard-Brazier cars of 1904 and 1905. In connection with the Paris-Berlin race it may be noted that Mr. Edge started on a Napier car, but retired on the first day owing to tyre and spring trouble. Mr. Jarrott, driving a Panhard car, arrived eighth, and Mr. Rolls, driving a Mors, arrived eighteenth out of 110 starters.

On June 28th, 1902, the Gordon-Bennett race was started as a part of the Paris-Vienna race. The Gordon-Bennett finishing point was at Innsbruck. On this occasion Mr. S. F. Edge won the cup for the United Kingdom. M. De Knyff on a Panhard was leading by a very considerable distance until, shortly before arriving at the winning post, his transmission broke. Although it may be admitted that this was a lucky accident in Mr. Edge's favour, it must always be remembered that he would not have won the race if it had not been that he persistently tried from year to year to gain the cup. There is no doubt that the Gordon-Bennett cup having been won by an English car, added new life to the British automobile industry and turned the attention of buyers to British cars.

As regards the race to Vienna, a distance of 615½ miles, this was won by Farman on a 70 h.p. Panhard car, with an average speed of 38·7 miles an hour. The most wonderful performance, however, in connection with this race was that of Mons. Marcel Renault, who was driving a light Renault car, which was the first to arrive at Vienna some three-quarters of an hour earlier than Farman.

No record of racing would be complete were it not to mention that the 35 h.p. Mercedes won the Nice-Salon-Nice race in the spring of 1901, and a 40 h.p. Mercedes the Nice-La Turbie race in 1902. These fine cars had a very marked effect on details in the construction of cars generally. Their silence and elasticity were quite astonishing, and so great was their influence on the automobile world that even the French constructors acknowledged that generally speaking it was as difficult to sell a car that was unlike a Mercedes as it would be to sell to a lady a hat which went out of fashion three years ago.

In the Circuit des Ardennes of 1902 Mr. Charles Jarrott, on a 70 h.p. Panhard, completed the distance of 318 miles (without controls) at an average speed of 54½ miles an hour. This was certainly one of the most exciting races ever witnesssed, inasmuch as it was run on a circuit, therefore the spectators were able to see the cars several times, and to judge of their relative positions. Gabriel, on a Mors car, was running just about the same speed as Mr. Jarrott, and when they passed the winning-post at the commencement ôf the last circuit, it was difficult to know which would win. On the last round, however, Gabriel lost his position through an accident to the chain of his car. The circular form of racing so recommended itself on this occasion that it was decided to introduce it in the race for the Gordon-Bennett Cup, which was held in Ireland in 1903, but on this occasion the course was in the shape of the figure 8, so that the spectators along the central portion of it saw the cars twice in one complete circuit. The distance of the race was 368 miles, and was won for Germany by Jenatzy, on a Mercedes, who averaged 49¼ miles an hour; Knyff, on a Panhard, was only beaten by some ten minutes. Mr. Edge, on a Napier car, was the only car representing England which finished the course, making an average speed of 35·1 miles an hour. Mr. Edge's car did the fastest circuit, but unfortunately he again suffered from tyre trouble. This race is interesting as being the only automobile road race which has ever been run in the United Kingdom, a special Act of Parliament being passed to legalise it. In the same year a very disastrous race was run between Versailles and Bordeaux. The intention was to race as far as Madrid, but, owing to the number of fatal accidents on the road to Bordeaux, the later stages of the race were abandoned. Between Versailles and Bordeaux, a distance of 343 miles, Gabriel, on a Mors car, made an average of 62½ miles an hour. In 1904 the Gordon-Bennett race was run in Germany, when Théry, on a Richard Brasier car, won, having covered the difficult course of 351 miles at an average speed of

$51\frac{1}{2}$ miles an hour. Théry, on the same make of car, again won a race for the Gordon-Bennett Cup in France in 1905 over a very difficult course of $351\frac{1}{2}$ miles at a speed of 48 2-5th miles per hour. Probably the most extraordinary performance over a long distance was that made by Lancia on a F.I.A.T. car. In America, in 1905, in the race for the Vanderbilt Cup, he covered 198 miles at an average speed of 69·9 miles per hour, but at this point when 21 minutes ahead of the next fastest competitor he had an accident and the race was eventually won by Hemery, on a Darracq, who made an average speed over the total distance of 283 miles of 61·5 miles an hour.

In the sprint racing recently in America, a Stanley steam car attained a speed of $127\frac{1}{2}$ miles an hour, while an 8-cylinder Darracq car covered two miles at the rate of $122\frac{1}{2}$ miles an hour. In connection with the Badminton Library book on motors, which was compiled by Mr. Alfred Harmsworth (now Lord Northcliffe), and in the preparation of which the writer of this paper took considerable part, there is a chapter on motor racing. The writer has recently produced for publication in the next edition of this book, a chart, showing the distance over which the famous motor races were run, and the average speed attained by the winning cars. This chart shows the average speed in 1894 as 12 miles an hour, the average speed in 1903 as 62·5 miles an hour. By the courtesy of the publishers, Messrs. Longmans, Green, and Co., a reproduction of this chart is shown on the screen to-night. This chart has hitherto not been seen by anyone, except the author and the printer. The subject of motor racing cannot be left without referring to the undoubted benefit which long distance racing was to the motor industry. The keen contests which took place between maker and maker and between nation and nation, have resulted in its being discovered by constructors that cars can, by the use of the very best material, be constructed within weight limits, which would not have been admitted as theoretically possible by consulting engineers ten years ago. Since 1901, however, there has been a feeling that the time would come when the racing of purely racing machines would cease to be of particular advantage in the design and construction of touring cars. The Automobile Club of Great Britain therefore started last year a new form of racing for what is called the "Tourist Trophy," in which the cars have to be *bonâ-fide* touring cars, affording a certain amount of seating capacity, and carrying four passengers or their equivalent weight on *chassis* of not less than a certain weight. The speed of the cars is limited by the fuel allowance, the same quantity of fuel being given to all the competing cars. The car which completes the distance in the shortest time, that is, the car which can most efficiently transmit the power obtained from the motor to the road wheels, and can cover the distance without running out of petrol and without delay, is the car which wins. In allowing a gallon of petrol for every $22\frac{1}{2}$ miles of the somewhat mountainous course in the Isle of Man, it was thought that the average speed of the cars would not exceed 25 miles an hour, whereas, as a matter of fact, the winning car, viz., the Arrol-Johnston made an average of 33·9 miles per hour on a fuel consumption of 25·4 miles per gallon, and the second car, a Rolls-Royce (the car in which the writer is commercially interested), made an average speed of 33·7 miles per hour, on a fuel consumption of 24·8 miles per gallon. It is thought by many experts that this new form of racing is likely to considerably improve the construction and design of touring cars, inasmuch as it compels makers to study the question of efficiency rather than to obtain speed out of their cars by means of engines which are unnecessarily large in order to overcome the inefficiency of transmission.

Sketch of the General History from 1898.

Having dealt as shortly as possible with the history of racing, one has to turn back to 1898 to review the general history of automobilism, and to recall that it was in that year that owing to the diplomacy of Mr. Roger Wallace, K.C., Chairman of the Automobile Club of Great Britain and Ireland, the club, and the Liverpool Self-Propelled Traffic Association, became amalgamated. This amalgamation was in every way desirable in the early days of a young and struggling movement. It was also in that year that the Automobile Club held its first tours. As an illustration of the capabilities of the touring cars in use in this country in 1898, it may be stated that London to Guildford was looked upon as a suitable distance to be undertaken in the course of an afternoon, and Guildford to Winchester in the course of a day. In 1898 we drove about London in electric cabs, but, seeing that they were being run at a loss of £300 a month, it

is not wonderful that the company which owned them went into liquidation. In 1898 Mr. Edge was riding an Ariel motor-tricycle on the track, and covered a mile in 1 minute and 47 seconds. In 1898 the then Prince of Wales, our present King, was driven by Mr. Critchley in a Daimler car. The fact that on arriving at a steep hill the car had to be pushed up it, surprised no one in those days.

The proud position which this country now holds in connection with motor vehicles for heavy traffic is undoubtedly largely due to the energetic action of the Liverpool Self-Propelled Traffic Association which, in May, 1898, held most useful heavy vehicle trials, the prime movers being Sir David Salomons, and Mr. (now Sir) Alfred Jones, the judges, Professor Hele Shaw, Dr. (now Sir) Boverton Redwood, Mr. E. Calthrop, and the organiser, Mr. Shrapnell Smith.

In the 1898 trials, cars were entered by the Lancashire Steam Motor Company, the Liquid Fuel Company, and Thornycrofts, but in a similar trial held in 1899, there were two Thornycrofts, one Coulthard, one Leyland, one Clarkson, and one Bailey vehicle submitted for trial.

The first purely motor exhibition, that is to say, an exhibition confined to motors and accessories, and not an exhibition in which motors formed part of an exhibition in which other goods were shown, was organised by the Automobile Club, and took place in the Old Deer Park, Richmond, in May, 1899. It was very difficult to pursuade anyone to identify themselves at that time with motors, and it was hoped that by getting some well known people to drive in motor-cars to Richmond for the opening of the exhibition, the path might be smoothed for those who from natural inclination took an interest in motors, but from public considerations thought that they ought not to do so. H.S.H. the late Prince Edward of Saxe Weimar, was good enough to open the exhibition, and a procession of motor-cars drove from the Automobile Club in Whitehall through Hyde-park to Richmond for the opening, in which among others were the following:—The Duke of Newcastle, Lord Rothschild, Lord Llangattock, the Hon. Evelyn Ellis, the late Lord Loch, the late Sir Francis Jeune (Lord St. Hellier) and Lady Jeune, the Hon. John Scott Montagu, M.P. (now Lord Montagu), and Lady Cecil Montagu, Lord Suffield, Sir David Salomons, Sir Richard Paget, the Hon. Charles Parsons, and Mr Alfred Harmsworth (Lord Northcliffe).

In spite of speed matches between Mr. Jarrott on a motor tricycle and a trotting horse by name "Goldring," and every endeavour to interest the London public in motor-cars, the attendance was so meagre as to involve the Automobile Club in a loss of some £1,600, but in view of the successful exhibitions which had been held in Paris, it was doubtless right for the movement in this country at that time that the exhibition should have been held.

Official Trials.

In connection with the exhibition, the first motor trials held by the club took place. The competing motors were required to ascend Petersham-hill, at Richmond, and their speeds were taken thereon. Tests were also made to ascertain the distance in which they could pull up when travelling down the hill. Electrical vehicles were tested by being required to run 33½ miles on one charge, and petrol vehicles were tested as regards reliability by being required to run 50 miles at a speed not more than 12 miles an hour. the then legal limit. At the same time, there were submitted to test under the club, heavy vehicles built by Thornycroft, Bailey, the German Daimler Company. and the Coventry Daimler Company. Sir David Salomons, Sir Boverton Redwood, Mr. Worby Beaumont, Professor Hele Shaw, and our Chairman of to-night—Colonel Holden, were judges. In September of the same year 1899, the *Daily Mail* started a series of weekly articles on motors with a view to educating the public as to the possibilities of the vehicles which Mr. Alfred Harmsworth had long since realised were the vehicles of the future. It is notable that these articles in the *Daily Mail* were started at a time when other journals were turning their backs on motors. In connection with these weekly articles there were founded 100 mile reliability trials held under Automobile Club observation, and one of the first vehicles entered was a Panhard chassis on which was fitted the first Napier engine. This was driven by Mr. Edge and ascended Dashwood hill at what appeared to us at that time to be a very high speed, viz., 9½ miles an hour. It was to Lord Northcliffe (then Mr. Alfred Harmsworth) that the writer first submitted the proposal for a 1,000 miles reliability trial all round England, and it was owing to his guaranteeing the club against loss that the club adopted the proposal, and that in 1900 the Automobile Club 1,000 miles trial throughout England to Scotland and back

to London, with exhibitions at the principal cities and towns *en route* took place. Many students of the movement have asserted that it was this trial which first awoke the British public to the true capabilities of the motor vehicle. Sixty cars were seen, each travelling 1,000 miles, 60,000 car-miles were accomplished with very few stops to the cars and no accidents to other road users. The speed possibilities of cars were shown by the time tests at Welbeck (a road for which was kindly lent by the Duke of Portland), and the public at last realised that they were face to face with the vehicles which were going to replace horses to a very large extent, which had come to stop, and were not the mere playthings of those interested in mechanics. Fortunately the club was not called upon to pay a penny in connection with this trial, nor was it necessary to take advantage of Lord Northcliffe's generous guarantee, he, however, gave prizes to the amount of £410.

A similar trial, on a smaller scale, was held by the club in connection with the Glasgow International Exhibition of 1901, and in subsequent years, with the Crystal Palace and Hereford as centres. The Scottish Automobile Club, under the organisation of Mr. R. J. Smith, has held and is still holding annually most valuable reliability trials. These trials have been undoubtedly healthy for the movement, inasmuch as they stimulated makers and are forcing them into competition, and at the same time, educated the public not only as to the capabilities of the cars under trial, but as to the capabilities and qualities of various makes of cars, and the standard of reliability which should be looked for from a car.

Legislation.

When first I had the advantage of talking with Lord Northcliffe (Alfred Harmsworth) on the automobile movement in 1899, this brilliant young journalist — who, by the success he has made in providing the public with the reading matter which they have required, has shown that he has an extraordinary genius for appreciating the public mind—predicted very exactly what would be the public feeling towards motors as they became more general. He foretold to me that the public would view motors first of all with scepticism and indifference, but, as soon as they had realised that motors were increasing in numbers, they would strongly resent the new comer, especially as horses would be frightened at them, and more especially as motors would be driven at speeds which had hitherto not been seen on the roads. He prophesied that this feeling would grow until Parliament would be forced to introduce some form of legislation for motors, which would satisfy the public mind. Year by year this prophesy has been fulfilled. Even before the Act of 1896 became operative, the chairman of a well-known county council recommended that all motors should be numbered. This recommendation was at once seized upon by county councils throughout the kingdom, who insisted that the Local Government Board should introduce a measure for the numbering of motor vehicles. Many of the county councils went so far as to recommend to the Local Government Board that the maximum speed of motor vehicles should be reduced to 10 miles an hour. So active was the opposition to motors that advantage was taken of the feeling of some magistrates and juries against the motorist, and vexatious prosecutions became not infrequent. This evil grew to such an extent that in 1900 a society called "The Motor Vehicle Users Defence Association" was formed, and did most useful work in showing that these vexatious cases could not be attempted without their being defended by a powerful Association.

As the result of a letter dated the 7th July, 1900, from Mr. Alfred Harmsworth, the Automobile Club commenced what is probably the most useful work ever carried out by it, and one which gained for it the adherence of many men who otherwise would not have joined it. I refer to what is usually known as its legislative campaign. This took the form of an invitation to every county councillor in the United Kingdom to attend demonstrations of motor vehicles given by the club in London, and in various other centres at which councillors and the chief constables of counties were given an opportunity of riding on motor cars, and could thus judge for themselves what was and what was not a reasonable speed, and as to the extraordinary control which the driver of a car has over his vehicle. After a year and a half's earnest work, the committee of the club had the satisfaction of seeing a deputation from the County Council Association recommending the Local Government Board, that although motor vehicles should be numbered, there should be no specific limit to the speed of motors. Although Mr. Walter Long, the President of the Local Government Board,

stated to the deputation that he looked upon a specific limit of speed as a source of public danger rather than a source of public protection, the feeling which Lord Northcliffe had predicted became so strong throughout the country, that when in 1903 motor legislation was re-discussed by the House of Commons, the Government had to give way on this point, and to agree to a specific speed limit of 20 miles an hour.

The writer wishes that time would permit him to record now, as he has endeavoured to record elsewhere, the value of the services which were rendered to the automobile movement by Mr. Roger W. Wallace, K.C., as first Chairman of the Automobile Club. The position was a most difficult one. Every step taken was one which created a precedent. There was no example to follow. The first motorists were enthusiasts. They were all regarded as more or less insane. A committee composed of enthusiasts, who were regarded by the public as only fit for an asylum, was not an easy commttttee to control. Mr. Wallace controlled it with consumate ability and tact, and sacrificed time, valuable opportunities of amassing wealth, and almost all else to the interests of the new movement. Colonel Holden, Colonel Crompton, Mr. Frederick R. Simms, Worby Beaumont, Lord Montagu, Sir D. Salomons, and many others (to whom unavoidably the writer is being very unjust in not mentioning their names) who ungrudgingly gave their time to the club and the cause, would, it is certain, be the first to join in this testimony of the importance of Mr. Wallace's services, as it in no way detracts from their own sacrifice in the same interests.

It is sure that mention of many men who took a large share in the history of the revival of motorism has been omitted, but it is impossible to mention everyone or every car. It will, it is hoped, be realised that the omission is not of the writer's wish, but of necessity.

Motor Union.

The protection of the rights of motorists was felt by the Automobile Club to be a matter in which all motorists should have a right to be interested, without regard to whether they were eligible for membership of the Automobile Club or not. Therefore, in 1901, in addition to the formation of automobile clubs in Scotland, Ireland, the Midlands, Lincoln, &c., the club formed a Motor Union, open to all motorists without election, which absorbed the Motor Vehicle Users Defence Association, and which since then, under the able secretaryship of Mr. Rees Jeffries, has become a body of more than 10,000 members, exercising great influence in the interest of motorism.

Motor Press.

The automobile press, which in 1895 consisted only of the "Autocar," now consists of the following papers:—"The Automotor Journal," founded by Mr. Stanley Spooner in October, 1896; "The Motor Car Journal," founded by Mr. Charles Cordingley in March, 1899; "The Automobile Club Notes and Notices," now called "The Automobile Club Journal," founded in 1899; "The Car Illustrated," founded by Lord Montagu of Beaulieu in May, 1902; "Motoring Illustrated," founded by Messrs. Kenealy in March, 1902; "The Motor World," founded by Mr. James R. Nisbet in September, 1899; "The Irish Motor News," founded by R. J. Mecredy; "The Motor," founded by Mr. Dangerfield in February, 1902; "The Motorist and Traveller;" "The Motor Trader," &c. It is scarcely necessary to point out the very important part which these papers played—popularising the motor.

Electric Cars.

Lest it should be thought that which the important part has been played by the electric cars as town carriages has been overlooked, the writer would beg leave to call attention to the system by which the electric carriages are garaged and maintained by the makers for the owners, which was first introduced on a large scale by Mr. Paris Singer in 1901, and which has been carried out on a more perfect system under Mr. Theodore Chambers by the Electromobile Company. The cars of the latter company are particularly attractive, and are by many considered to be the ideal motorcar in consequence of their ghost-like silence and the mystery of their swift movement through the London streets.

The history of the steam vehicle has not been encouraging prior to the introduction of the White steam car. Mons. Léon Serpollet has from the outset of the revival of motors devoted much energy, time, money, and ingenuity to the solution of the steam problem, and has produced touring cars which ran very charmingly, and racing cars which ran very fast. The statistics of exhibits at the big exhibitions show that whereas in 1903 11 per cent. of the vehicles exhibited were propelled

by steam, at the exhibition held at Olympia last November only 4 per cent. of the vehicles displayed were steam vehicles.

Steam Cars.

Another form of car which has become deservedly popular is the steam car, the most popular undoubtedly being an American car known as the White steam car, concerning the evolution of which the following notes may be of interest.

The first White steam car was made in 1900. The 1900-1901 type was a 6 h.p. runabout, two-seated, without a condenser, and equipped with a simple two-cylinder engine. The boiler consisted of eleven coils of three-eighths of an inch seamless drawn steel tubing, so arranged that water was pumped into the top and superheated steam taken out of the bottom. Furthermore, the coils were so connected that the water in the boiler did not fall from one tube to another by gravity. The regulation was automatic, the fire being regulated by temperature and the water by steam pressure. It was the first boiler made, which could be run dry of water at any time without the slightest danger of damage. The changes in the White car from 1900-1906 have been great in every way, except in regard to the system of steam generation, which has remained the same. 1902 saw a condenser added to the 6 h.p. car. 1903 saw a four-seated 10 h.p. tonneau White car, with two-cylinder compound engine and an average non-stop capacity of 100 miles. 1904 saw practically the same car, refined and strengthened in many ways. In 1904 the White Company produced 674 10 h.p. cars. 1905 saw the car enlarged to 15 horse-power, with an average non-stop capacity of 150 miles, 1,200 of which were made in the 1905 season. 1906 saw the car again enlarged to 18 horse-power, and a chassis so arranged as to allow for the first time a side entrance body to be fitted. The White Company will have finished their 1,500th 18 h.p. 1906 car by July 1st. Altogether, the White Company have produced about 4,000 motor cars in from five to six years.

Historical Cars.

The writer thinks he should mention, that in the preparation of this paper, apart from the kind consent given by Lord Montagu of Beaulieu to make use of papers contributed by him to the Car Magazine, he has found great difficulty in obtaining particulars of some of the early motor-cars in spite of the courtesy and assistance of the manufacturers, or their agents. Some years ago, when secretary of the Automobile Club, the writer addressed a letter to the Science and Art Department at South Kensington, asking whether if the Automobile Club could procure some of the first petrol motor-cars made, the museum authorities would find space for their display and preservation, but, the reply which might be expected from a Government department was received, namely, that they had neither space nor money for such a purpose. It is difficult to imagine anything more interesting than would be a really good collection of some of the earliest automobiles. For instance, Levassor's car of 1894, with its Daimler engine and the general arrangement laid down by Levassor which has held good till now, and as far as one can see may hold good for some time, would in a few years time be of almost priceless value for any national collection. If, in addition to this, there were displayed cars of each year, showing the gradual development of the motor-car, the collection would be unique. Sir John Macdonald, the Lord Justice Clerk of Scotland, has over and over again urged the desirability of forming such a collection. The writer has frequently urged the committee of the Automobile Club to form a collection of models of the early cars, each model being to one scale, and mounted on a locked pedestal containing the fullest possible particulars of its construction and design, photographs, &c., but, apparently the Automobile Club, like the Science and Art Department (now the Board of Education), have other matters which they consider of more importance. The Society of Arts would be benefiting the nation at large if it could arouse the Board and the Automobile Club, to the desirability of forming such a collection without further delay, and to the appreciation of the fact that every day's delay makes the formation of such a collection more difficult, if not impossible.

In conclusion, the writer wishes to thank the Motor Union, Sir David Salomons, Mr. Staner of the *Autocar*, Mr. J. H. Knight, Mr. Siddeley of the Wolseley Company, Mr. S. F. Edge, Mr. Coleman of the White Steam Car Company, Mr. C. S. Rolls, and many gentlemen who have kindly lent lantern slides for the illustration of this paper. He has had certain slides including portraits of the Fathers of the movement prepared, and

these he will present to the Motor Union. He desires especially to thank Colonel Holden for honouring him by taking the chair, to thank the Council of the Society of Arts for permitting him to read the paper, and the audience for being good enough to listen to it.

Then and Now.

Seven years ago, at the Richmond Show, there was only one 4-cylinder motor, now nearly all motor cars, except the lighter and cheaper classes are fitted with 4-cylinder motors, except those with the 6-cylinder motor, which were first introduced by Messrs. Napier and Edge three years ago, and those fitted with 8-cylinders. The 6-cylinder motor is without doubt gaining ground, seeing that one crank-shaft maker alone in this country is making 6-cylinder crank shafts for 13 firms. Mr. Edge's 6-cylinder car held the world's record for speed last year. The 8-cylinder motor "V" type, which is built by Levassor and was used in motor-boats last year, has been adopted by the company in which the writer is commercially interested, in motor-cars, the first cars fitted with one being shown at the last exhibition at Olympia, and the 8-cylinder "V" motor has since then been adopted by the Darracq Company on their racing car, with which they have attained the speed of 122½ miles an hour.

Seven years ago, although Benz, Mors, and others were using and had always used electric ignition, Panhard and Daimler were still using tube ignition, and the only magneto shown was that fitted to Mr. Simms' motor cycle. To-day tube ignition has been abandoned, and the magneto is rapidly taking the place of electric ignition.

Ten years ago the *Daily Telegraph* thought that we were not within measurable distance of the day on which the people in Society would use electric carriages for town work. Six years after this wise announcement most of the leaders of London Society were using electric carriages, and to-day there are said to be 500 electric carriages in use.

Seven years ago at the Richmond Exhibition there were 130 motor-cars and commercial vehicles, and 16 motor-cycles exhibited. Last November at Olympia, there were 496 vehicles shown, of which 56 per cent. were British vehicles, 93 per. cent. were petrol, 4 per cent. steam, and 3 per cent. electricity.

Seven years ago a motor exhibition involved a loss of £1,600; now a motor exhibition means a profit of many thousand pounds.

Six years ago the writer spent many hours in watching on the big highways leading out of London for passing motor-cars without seeing one, and if he did see one, he could at once recognise the owner and make of the car. Now one can scarcely cross the road without having to run to avoid a motor-car, and the makes of cars are so numerous that it is difficult to identify them.

Twelve years ago the average speed of a racing car over a long distance was 12 miles an hour. To-day, the average long-distance speed is 69 miles an hour.

Eight years ago there were 163 members of the Automobile Club. Now there are 2,860.

Seven years ago one was regarded as insane if one drove a motor. Now one is regarded as insane if one does not drive one.

Two years ago a motor-omnibus was regarded as a curiosity. To-day there are 260 running in London.

Seven years ago there were only a few people who drove motors. Now there are so many drivers of motors that the receipts of the railway companies have been seriously affected.

Seven years ago the annual output of cars of the motor companies in this country could be counted in scores. This year the Daimler Company—which last year made a profit of £80,000—hopes to turn out over 1,000 *chassis*; the Argyll Company hopes to manufacture 1,500 complete cars this year; the Napier Company claim to be turning out *chassis* having a selling value of half-a-million pounds per annum; and the Wolseley Company employ 2,000 men, and have a wages-bill of more than £150,000 per annum.

Probably the salaries and wages paid in this kingdom in the motor industry amount to £1,500,000 per annum, and the turnover to £5,5000,000.

The paper has, owing to the necessity of brevity, been full of dry fact. When one has to travel from one place to another in a time which is all too short for the purpose, one cannot stop on the road to gather flowers: so to-night it has been impossible for the writer to relate many incidents by which this paper might have been relieved from its tediousness, but it is hoped that when its facts are carefully considered and reviewed, it will be recognised that the paper presents, although in an unattractive form, material which in the hands of a good writer, might be worked up into a fairy tale which would have been looked upon as impossible of accomplishment had it

been placed before the public twenty years ago, and might have to-night been presented in the form of one of the most fanciful valentines it is possible to devise.

DISCUSSION.

The Right Hon. Sir JOHN MACDONALD, K.C.B., in opening the discussion, said that he had taken a very great interest in the automobile movement from its very commencement, the chief reason which had induced him to do so being the consciousness that his countrymen, both in England and in Scotland, although not so much in Ireland, were difficult people in whom to arouse enthusiasm about a new thing, however good. As soon as a new thing was suggested to anybody in this country he immediately tried to find out how it would not do, to call it bad names, and try and crush it if possible. The greater the prospect of its success the more was the eagerness to crush it before anything could be done, and that spirit well illustrated what had taken place in the history of motor cars. In 1830-33, as the author had said, an entirely successful movement was started for the development of motor traction upon roads, but it was stopped by obstruction of the most disgraceful kind. A Committee of the House of Commons reported that scandalous and even criminal means had been used to crush out a movement which would have tended greatly to the benefit of the country in a commercial and social respect, and also in the way of sport. The result had been that the roads had been very little used for the last fifty years, and had consequently fallen into a disgraceful state of disrepair. It was to be hoped that the fact that the motor-car had taken possession of the roads would give an impetus to their improvement. That was the next step which must be taken in the progress of the movement, and it would be a benefit to everybody. His interest in the subject was not in the sporting direction. It was no doubt a very delightful occupation to drive about the country in a motor-car, but he earnestly urged people not to consider the subject from that point of view at all, but from the aspect of the benefit it would confer upon the country, particularly agricultural districts. It was a very curious fact that the bitterest opponents of the motor-car had been those who would ultimately benefit most by it, namely, people who lived in the country, squires and innkeepers. Motor cars would bring money into districts where it was very scarce at present, and it would enable agricultural people to send their produce into large towns, where it would find a ready market, without being oppressed by the scandalous rates which were charged by railway companies to people in this country, while at the same time they gave cheaper rates to foreigners who landed goods on our shores. The industry was progressing rapidly in Scotland, and in his own city of Aberdeen, where eight years ago there were, he believed, only two cars, he noticed a car numbered 555 running in the streets quite recently, and he believed that that number was 150 behind the actual total. It was proposed to disfigure one of the most beautiful scenes of Scotland, within a stone's throw of Loch Lomond, by the erection of an enormous factory, capable of employing 2,000 workmen, for the purpose of making motor-cars. He sincerely hoped that all automobilists would study a subject which had not been considered sufficiently in the past, namely, a moderation of their conduct with regard to the interests and comfort of others. He assured automobilists, from personal experience, that a great deal more pleasure was to be derived from a drive where the average speed was eighteen or nineteen miles an hour, where the driver checked the speed when passing people, and did not spatter them with dirt or cover them with dust, than in tearing along at 35 or 40 miles an hour, having the clothes nearly torn off one's back, and being so desperatively attentive to the wants of the car that there was no time to admire the scenery. If automobilism was to be a sport, it should be a real sport, and not one which did not have regard to the feelings of others. He was quite certain that the development of a kindly spirit on the part of automobilists would make them the greatest friends of all people on the road. Of course, in case of necessity, where, for instance, a lady was taken ill suddenly in the night and the presence of a doctor was necessary, it was possible for the medical man to arrive, say, in $1\frac{1}{2}$ hours instead of four hours; but he appealed to motorists to act under all circumstances as gentlemen, and as people who had an earnest desire to make things pleasant all round.

Sir BOVERTON REDWOOD thought it was some slight compensation for living in the present days of upheaval when people's idols were being overthrown and some of their cherished fundamental beliefs seriously shaken if not utterly uprooted, that they were privileged to observe and take advantage of the wonderful epoch-making change in locomotion which had been so ably outlined in the paper. It might not, perhaps, be altogether without interest if he remarked that it could not be more than eight years ago that he found it necessary to undertake a journey to Coventry for the purpose of appearing before the Board of Directors of the Daimler Company who were strangely unwilling to accept an order which he desired to give them. The difficulty arose from the fact that the directors were not quite clear as to how far they might be making themselves seriously responsible by furnishing him with what he asked for, viz., a 4-cylindered car of 12 horse-power. He clearly saw, when he had an opportunity of discussing the matter, that they thought he might use such a terrible engine of destruction, as it then appeared only a few years ago, for the purpose of manslaughter or of suicide, and he assured those

present that it was with grave misgivings the Company finally accepted his order. But, before the car was finished, the views of the directors, and others who had opportunities of studying the subject, changed to such an extent that the car was submitted to the inspection of the King—at that time the Prince of Wales—and he believed it was one of the first cars in which his Majesty rode in this country. That gave some idea of the marvellous rapidity with which the particular form of locomotion under discussion had developed. He was glad that he had been called on to speak, because it afforded him the opportunity of expressing his sense of indebtedness to the author for the remarkably interesting paper he had given.

Lieut.-Colonel ALLAN CUNNINGHAM said he did not wish to appear hypercritical, but he thought the title of the paper, "The Horseless Carriage," was a very wide one, because it would not only include petrol, electrical, and steam-propelled carriages, but it might also be said that the perambulator, pushed by a nursemaid, or by the familiar goat-cart, were also horseless carriages. Carriages propelled by means of kites had been successfully used, although not sufficiently to be practical; but he believed that if experiments were pushed far enough there was no reason why carriages should not be propelled by the use of windmills or some other application of wind power.

Mr. F. J. SHARPE asked the author whether, in view of the fact that the tyres were the principal source of difficulty in the present motor omnibus, he thought the iron tyres which were unsuccessfully used on the old steam cars because of the jolting they caused, could not now be used.

Mr. LEON GASTER enquired whether the author thought that alcohol would ever be able to compete with petrol for use in motor cars, because it was now possible to produce alcohol from potatoes at a low price. He also thought Mr. Johnson had not done justice in the course of his remarks to the present electric motor-cars, which were a great improvement on the patterns in use a few years ago.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Johnson for his most instructive and fascinating paper, said that those who had followed the rise and progress of the motor-car could not but be astonished at the enormous progress which had been made in an incredibly short time. He thought the fact could be attributed to two causes; in the first place, the intense interest which had been taken in the motor-car by people interested in the automobile for its own sake, and, secondly, the wonderful facilities which at present existed for perfecting any piece of mechanism. When it was remembered that, within ten years, the speed of the fastest motor-cars had been raised from about 10 miles to $127\frac{1}{2}$ miles an hour, it must be acknowledged that the advance made was little short of miraculous. It was also a universally accepted fact that, without the introduction of the pneumatic tyre, it would have been impossible to attain such enormous speeds on racing machines. The general public, and motorists also, were inclined sometimes to ask what was the use of such extreme speeds. At first sight, it did not appear that they served any useful purpose, apart from racing considerations; but they had had the effect in the past, although they probably would not to such a great extent in the future, of improving the mechanism, the build and the design of the motor-car. It was, therefore, inadvisable to abolish speed trials altogether, although they were out of place on ordinary roads; and so long as they were useful in improving the motor-car itself, it was probably desirable that they should be held. What was wanted for this and other countries was a perfect means of locomotion, not only for passengers, but for goods; and until that was obtained motorists and the advocates of mechanical transport would not be satisfied.

The resolution of thanks having been carried unanimously,

Sir JOHN MACDONALD, in reply to some of the questions asked, said that the vehicles running on the roads in 1832 to 1833 were constructed in an entirely different manner from those at present in use. The cars were hung upon leather straps underneath the carriage, and of course would have been shaken to pieces had they travelled at the speed in use at the present time. They were only intended to go 12 miles an hour, and in that respect they were entirely successful. Mr. Gaster had suggested that cheap alcohol might be used, but he was afraid that it would not be able to be made cheap enough, even out of the worst potatoes, to enable it to compete with petrol. As the author had said, electrical carriages at first were a failure, one company losing £300 a month on them. He thought that was due to two reasons; in the first place, because they were not constructed so as to work satisfactorily, and, in the second place, the public did not learn to use them at the time. At the present moment electrical carriages were running with very great success.

Mr. JOHNSON, in reply, after thanking the members for the very cordial vote of thanks they had accorded to him, said that when writing the paper he found it would be an altogether impossible task to compress the history of the horseless carriage within the short space at his disposal, and he therefore thought it better to deal thoroughly with one subject than hastily review many. In reply to what had been said with regard to the subject of electrical cars, he thought they were the most beautiful things ever created in the way of a motor-car. He had not studied the subject of locomotion on the road by means of windmills or goats, but he had

no doubt such subjects might be dealt with at the Society of Arts at a later stage in its history. He could imagine several subjects on which interesting papers might be written in the future; and it might occur that the first secretary of the Submarine Club would read a paper on the History of Submarines, beginning with the time of the first submarine excursion—that of Jonah; or the first secre- of the Aero-Club would read a paper on the History of Aero-planes from the time of Icarus; but, at the present moment, it only remained for him to thank the Council of the Society of Arts for doing him the honour of asking him to read the paper, the gentleman who had lent the lantern slides, and the audience for so kindly listening to his paper.

Sir Boverton Redwood writes:—I have now had an opportunity of reading a proof of the paper on "The Horseless Carriage," which, owing to its length, was necessarily presented last night in an abbreviated form, and I find that the author, with natural modesty, has made no allusion to his own services to the motor movement as secretary for many years to the Automobile Club.

As one who, during the period in question, worked with Mr. Claude Johnson, I therefore wish to add to the few remarks I made by recording my sense of the courtesy, zeal, and remarkable organising ability which he consistently displayed, often under discouraging conditions, for the self-propelled vehicle was then unpopular, and its advocates regarded as misguided enthusiasts. Mr. Johnson's unfailing tact and conciliatory good humour were of great value in these circumstances, and the automobile industry owes more to his unassuming labour at this critical time than is generally known.

COTTON.

Recently published consular reports refer to the development of cotton-growing in various countries, and it may be useful to take note of the facts. Much is hoped from Rhodesia as a cotton-growing area, but at present the cultivation is insignificant. On the Lower Shiré river a promising experiment is being made by a British company. In January, 1904, this company planted a small area with Egyptian cotton. This did well, and the following July the trial crop was sent home. The cotton was pronounced to be of unusually large staple and good quality, it was spun into 60's yarn by a Lancashire mill, and was valued at 7¾d. lb. or 8d. per lb. As a result, the company decided to enter upon cotton-growing on a large scale. At the present time over 2,000 acres are under cotton, and costly machinery has been obtained from the United Kingdom, and is now practically ready for the work of ginning and pressing the crop. Samples of the present (1905) crop prove to be worth 7½d. per lb., which, in view of the fall in prices on the cotton market, is considered satisfactory. The company estimates that this year's crop, raised without artificial irrigation, will yield between 1,500 and 1,800 bales, weighing 400 lbs. each, an average of from 325 to 350 lbs. per acre. The soil is alluvial and rich, and it is anticipated that no artificial manures will be required for several years. The labour for the plantation comes mostly from British and Portuguese Angoniland, and the men have shown fair aptitude for the work. The time for planting is from December to February, and is coincident with the commencement of the rainy season. So far the prospects are encouraging, even though the cost of transport from Chiromo, on the Lower Shiré, to Liverpool is £2 7s. 6d. per ton (40 cubic feet). The particulars here given rest on the report of Mr. Vice-Consul Hewitt-Fletcher, dated Chinde, July 13, 1905 (No. 3495, Annual Series).

Reporting on cotton-growing in the Argentine Republic (No. 639, Miscellaneous Series), Mr. Consul Ross refers to the ginning mill of the Anglo-Argentine Cotton Company, a mile from Resistucia. The cotton is bought from the growers for 13 cents per kilo. delivered at the factory. The area planted last year is estimated at from 6,200 to 14,800 acres. Mr. Ross says the business of cotton-growing promises well. The best land gives an average crop of 3,500 kilos. of seed cotton per acre, and will in good years give 4,500 kilos. Second-class land will average 2,500 kilos., with frequent returns of 3,500 kilos. Probably a fourth of all the arable land comes under the first class. The cost of picking, employing the very unskilled labour that is available, is high—about 5s. 3d. per cwt. The cost of seed and tillage up to the time of picking is, roughly, £1 1s. per acre, so that the crop from an area of, say, 3,500 hectares would cost for seed and tillage 30 dols.; picking, at 6 cents per kilo., 210 dols; together, 240 dols.; and the return would be 3,500 kilos. at 13 cents, 455 dols., or, say, a profit of 215 dols. per hectare, or about £7 per acre. The planter would grow other crops in rotation with cotton which would more than provide the living of his family, and the interest on the money invested in land, stock, and implements, so that the profit made on the cotton would be all clear gain, that is of course assuming cultivation under favourable conditions. The main difficulties in connection with the industry are—(1) labour; (2) transport; (3) the ravages of caterpillars. The supply of Indian labour has been sufficient for the comparatively small area of land that has been planted with cotton; it is doubtful if it would be if the area was largely increased. The difficulties of transport might be overcome by an association of growers or mill owners for the purpose of acquiring the plant (lighters and tugs) necessary for the transport from one of the river ports in the Chaco to an ocean seaport down river, but Mr. Ross does not say if such an association is

likely to be formed. As to the caterpillar, an entomologist from the Agricultural Department of the Argentine Republic has been studying it, but it has not been determined whether it is actually the cotton caterpillar (*Aletia argillacea, Hübner*), although it produces the same effects on the cotton plants, and can be combated by similar means.

Coming nearer home, there is a project on foot which seems likely to take definite shape, for the extension of cotton cultivation in Italy. During the American Civil War, when cotton rose to famine prices, a great deal was grown in Italy, and the crop continued to be cultivated till 1871, when about 200,000 acres were covered with it. When the price of cotton fell, the scarcity of wine in France made wine a more profitable export, and there was also a spasmodic rise in wages, which caused peasants to give up their cotton crops in favour of vines and other fruits, which yielded more substantial returns. At the present time, there are not more than 10,000 acres under cotton, of which the greater part is in the Neapolitan district and in Sicily, but in his report on the trade of South Italy (No. 3496, Annual Series) just issued, Mr. Consul-General Neville-Rolfe says, "it is an undoubted fact that large tracts in South Italy, as well as in Sicily and the island of Sardinia, could produce cotton plentifully and of good quality." The few thousand bales now grown scarcely affect the demand from America, to which country Italy pays between six and seven millions sterling per annum for the raw material to supply her numerous and rapidly increasing cotton mills. The reasons which determined the abandonment of cotton growing have now disappeared. Rapid transport has opened up markets for many products which formerly could only be procured from Italy. America largely grows her own fruit, the United Kingdom is looking more and more to the West Indies and other sources than Italy, and vine cultivation is not as profitable as it was. Cotton is a crop which enriches the soil, and its cultivation improves the crop which follows it very materially, so much so that experimentalists say that the following corn crop is as much as 20 per cent. better after cotton than after any other green crop. In Italy, too, cotton is sown in April, and gathered in October, and as all corn is cut by the beginning of July the land which is to be under cotton in the following April can quite well grow an intervening crop, and thus add considerably to the profits of the farmer. Under these circumstances, it is not surprising that a large extension of cotton cultivation in Italy is being considered.

There have been frequent references in the *Journal* to the efforts that are being made to largely extend the growth of cotton in the British West African Colonies, the West Indies, Egypt, and other countries under the control of Great Britain. The abnormal crop in the United States last year, by fully meeting the immediate wants of Lancashire, has somewhat weakened the support that would otherwise have been given by Lancashire to those who are working for the expansion of cotton cultivation within the British Empire, and probably it will be many years before the United States cease to supply the bulk of the cotton used in Europe. But in various parts of the world, as will be seen from what is stated above, the expansion in the near future of the area under cotton cultivation is probable, and may almost be said to be certain.

CHINESE CARVINGS IN PARTI-COLOURED HARDSTONES.*

A very high degree of skill in the treatment of unpromising materials for the production of artistic and beautiful cameos has been reached by the Chinese. People of other nations have obtained, perhaps, a greater beauty of line, a higher perfection of detail, or a truer adherence to nature, as it appears to European eyes, but these results have come with stones the arrangements of whose layers was regular, and whose disposition could, with more or less certainty, be determined in advance. The Chinaman, on the other hand, seems able to utilise any stone having differences of quality or colour, obtaining from it, by the exercise of his ingenuity and patience, an object of beauty. Though he seldom attempts great detail in cameos, it is propably not from lack of ability, as his work in other materials shows, but because his treatment of a subject differs from ours; in contrasting colourings and in perfecting the finish he is not to be excelled.

Under his skilful hand an apparently worthless agate pebble becomes a pendant whose varied tones are properly arranged; what would ordinarily be a blemish in a jade or crystal is turned to a valued addition; a thin, dark patch, far in the interior of a translucent stone, is brought to the surface to be changed in outline; or a crack or flaw is so worked into the design as to be scarcely perceptible; and all this is so done that one who examines the work does not at first realise the remarkable skill and patience it represents.

If we include all objects in which differences of colour have been utilised by bringing them more or less into relief in the design, their list becomes a long one. In the greater number of them, however, the actual cameo portion is only secondary to, or a very minor part of the main design. Pendants and snuff bottles offer the best opportunities for the display of the artist's ingenuity, some of the former, in particular, showing a marvellous skill in the manner in which a number of differently coloured, irregularly-disposed, layers have been utilised.

To give an idea of the Chinese work a number of actual specimens, typical of the various classes of carvings, will be described. Such are the following:—

Larger pieces:—

Jade. A buffalo with a Chinese unicorn at its side; the buffalo in greenish white, the unicorn in black.

* Communicated by W. L. Hildburgh.

Jade. A sage holding a fruit, and a boy; the face and hands of both, and the fruit, whitish, the remainder of the piece brown.

Jade. A sage carrying stalks of grain, and a boy with emblems; the grain and the emblems lighter in colour than the remainder.

Jade. A pair of deer; the horns and ears of the larger, and some sprays of vine held by each, of a lighter colour than the remainder.

Carnelian. A bowl in the form of an up-curled leaf in white, with smaller leaves, and flowers in very high relief, in red.

Carnelian. Flowering branches, in red and white, the white branches bearing red flowers, the red branches white flowers.

Pendants:—

Jade. A black crab resting on the white leaves of an aquatic plant.

Jade. A boy; the upper part of his body nude and of white jade, the lower part, clothed, of black.

Jade. Two nuts; one black, the other white.

Jade. A white fish lying upon a green leaf.

Sardonyx. A whitish monkey surrounded by dark branches.

Sardonyx. A boy with a pair of shoes slung from his back; the shoes cut from the opaque, partly decomposed, exterior layer of the nodule in such manner that their soles and uppers differ in colour. A large brown internal marking in the translucent agate of the head is utilised for the boy's hair.

Agate. A gnarled flowering branch; the knots cut from concentrically-marked portions of the stone, and the flowers and wood differing in colour.

Crystal. A rat in clear crystal, upon a bunch of grapes in amethyst.

Agate. A rat, with several nuts having dark smooth shells, of a second colour, and some ground-nuts in opaque, partly decomposed, crust.

Agate. A bird upon a flowering branch, five layers being employed; the flowers, the leaves, and the branch, of differing colours, and the bird being cut to show various layers for the breast, back, and head.

Belt-buckles:—

Jade. A dragon-headed hook, with a smaller dragon upon the level portion; the upper part green, the lower white.

Jade. Base white, with the head and decoration of dark grey, cut in open work as fungi.

Agate. A panel for a metal setting. A base of light brown, upon which is a leopard, cut from a mossy layer, in high relief, the "moss" being in spots which represent those of the animal.

Agate. A panel for a metal setting. A base of light brown upon which, in high relief, is a wading-bird whose head and body are grey, whose wing is white, and whose bill is the colour of the base.

Mouth-pieces:—

Mouth-pieces for pipes, of agate decorated upon one slide with a cameo, are fairly common; the stone is ground to expose a darker layer, which is then cut as desired.

Snuff-bottles:—

Crystal. Body clear, with a high relief of a vine and a squirrel, in green, upon one face.

Crystal. Back-ground, foliage, and body, clear, with two cocks and the sun cut from a naturally-stained yellow portion.

Crystal. Clear, and cut in the form of an old man with a gourd upon his back, and a boy; the gourd cut from a naturally-stained yellow portion.

Crystal. Clear, with a bird in white root-of-crystal, in high relief.

Crystal, with a layer of white root cut as birds amongst lotus.

Crystal. Smoky, with six faces; upon three faces the white root has been left, and worked into a design of branches and flowers.

Crystal. A smoky, naturally-symmetrical 6-sided crystal, having a cameo of opaque white root on each face. The cameos are, in order, a flowering tree, an old man, a goat, a goat, a goat, an old man.

Crystal. Clear, with two dogs in hair crystal, in relief, the black "hairs" being skilfully used for the hair and tails of the animals.

Jade. Grey, with a very thin layer of brown on one side; from the outside of a nodule.

Jade. Body of pea-green, with five dogs, principally in brown, in high relief, playing with a ball.

Agate. Yellowish brown, with small dark brown patches, the surface carved with a landscape and figures delicately cut in low relief, the dark patches being used for the dresses and hair of the figures, and for the foliage of the trees.

Agate. Clear greyish, with a dark brown patch cut as a man, a boy, the ground, and the roots and trunk of a tree beneath which the figures stand. The foliage of the tree is an uncut portion of the patch, at the surface of the bottle.

Agate. Greyish and brown, with dark brown patches brought to the surface and cut as three monkeys playing with a butterfly.

Agate. Clear greyish, with a large brown and yellow included patch in the form of a tree trunk, upon whose single limb a bird, cut from the same patch, is perched.

Agate. Greyish, with dark brown patches. The patches have been left in the body of the stone, just level with the surface, and the surface has been arranged so as to form the patches into various designs: a man with two animals, a flowerpot and plant, &c.

Agate. Clear brown, with a dark patch upon each face cut as a cameo. On one face a bird beneath a tree; on the other a bird feeding, and a large vase of flowers.

Agate. Clear brown, with an opaque light layer cut as a horse, a tree, and a monkey.

Agate. Clear greyish brown, with opaque light patches half sunk in and bordered by clear dark brown. The patches cut as a monkey, a unicorn, a bird, and a butterfly.

Agate. Clear grey, with dark parts cut as lotus

leaves and a fish, and with stems and other parts of the plants in grey agate; all in low relief.

Agate. Clear brown, with dark brown markings upon the surface and in the interior, worked into the designs of a gourd vine, bearing fruits and a flower, about which several bats hover.

Agate. Clear brown, with a darker layer cut as a high relief of a vase with flowers, and a bird upon a sceptre of longevity.

Agate. Clear brown with a high relief of a bird attacking a dog, in yellowish brown.

Agate. Clear greyish brown, with a thin yellowish brown layer; a horse, in high relief, in the greyish brown, with its saddle, harness, mane, eyes, and hoofs, in yellowish brown.

Agate. Body of clear greyish brown, with an opaque dark green layer, from which a bird, on a piece of bamboo with branches and leaves, is cut. The effect is enhanced by the plane of the green layer being irregularly disposed with respect to that of the surface of the body of the bottle.

Agate. Purplish grey, with two layers above, the upper green and green and red, the lower brown. The green portion cut as a tree, the red and green as soil, rocks, &c., and the brown as birds. On the reverse the red and green as the leaves of an aquatic plant, spots in the stone being utilised for stalks and flowers.

Agate. Brown, grey, and light brown, the carving supplemented by the natural colourings. A dragon, in low relief, arising from waves during a storm. Swirling rain represented by streaked grey, and lightning by natural markings in the light brown. On the reverse a red spot formed into a ball, between clouds and waves.

Hardstone. Olive green on one side, white on the opposite; on the latter a coiled dragon in high relief.

AGRICULTURAL SCHOOLS IN BAVARIA.

In order to promote agricultural interests the authorities in Bavaria have established agricultural schools in thirty-one towns. These schools are in charge of teachers, who, in addition to an academical education, must be generally efficient in botany, geology, chemistry, physics, zoology, and natural history. At a time when there is little or nothing doing in the fields, from November to March, these schools are open, and peasant farmers for a nominal fee can attend courses on cultivation and fertilisation of the soil, the proper succession of crops on the same land, the best sources for good seeds, irrigation, and the breeding of stock. They are made acquainted with improvements and new inventions in agricultural implements, the adoption of which can be recommended. They are taught the rudiments of book-keeping, and other commercial knowledge is imparted essential for the practical farmer. In the spring, after these farmers have returned to their work in the fields, it becomes the duty of the teachers who instructed them during the winter to travel from place to place, and to act as advisers to the farmers. Much benefit, it is said, is derived from the instruction of these travelling teachers. By practical suggestions to the farmers they induce them to make valuable improvements in the cultivation of their farms. The travelling teacher helps to form co-operative clubs for the joint interests of a number of farmers in one district. From time to time the teacher has to lecture in these clubs on any subject, practical or scientific, which might prove of interest to the members. These visits and lectures to the different districts are entirely free to the people since the State defrays all the expenses. There is probably no other country in the world in which so much is done by the State for its rural inhabitants as is the case in Bavaria. Other German States have their agricultural schools, but their teachers are not sent in such a practical way direct to the places where they can do the most good, as is done in Bavaria.

ARTIFICIAL PUMICE STONE.

The American Consul at Frankfort reports a German invention by which artificial pumice stone is produced by a mixture of sand and clay. Pumice stone, aside from its uses as a cleaning agent, belongs to the most important polishing substances. While emery is used for polishing tools, polishing paper for stone and glass, oxide of iron for fine glass ware, and lime for metals, pumice stone is employed for polishing softer articles. Pumice stone as found in nature is, according to its composition, nothing but lava which has received its foam-like porosity through the fact that the volcanic stone substance was cooled very rapidly under strong development of gases. Natural pumice stone, which for industrial purposes comes almost exclusively from the island of Lipari, is of little firmness, and for that reason experiments have been made for some time to find an artificial substitute of greater durability. This seems now to have been accomplished, through a German invention under which artificial pumice stone is made by mixing sand and clay. This artificial pumice stone is made in five different kinds. The first is either hard or soft with a coarse grain and used for leather, waterproof garments, and for the felt and woollen industry. The second can also be supplied hard or soft It has a medium grain and is mainly used for stucco and sculptural work, as also for rubbing wood before painting. The third is soft, of fine grain, and is recommended for polishing wood and tin. The fourth is of medium hardness and fine grain, and gives to wood the right polish before being finished with oil. The fifth is hard and of fine grain and used for polishing stone, especially lithographic stone. The manner of using is the same as for natural pumice stone. For wood it is first used dry, afterwards mixed with oil.

HOME INDUSTRIES.

The Cotton Crop, 1905-6.—In the *Journal* of December 29th, 1905, calculations were given as to the probable total of the American cotton crop for 1905-6. The estimate of the Crop Reporting Board of the Bureau of Statistics of the Department of Agriculture has just been published, and gives a total production of 10,107,818 bales. But it was pointed out that taking the last six years the Government estimate had been an average under-estimate of 5·5 per cent., or about 600,000 bales. This under-estimate had, however, varied widely as from 0·3 per cent. in 1903, to 10·3 per cent. in 1904. Assuming the average under-estimate for 1905-6, the actual yield would be 10,767,000 bales, and the latest estimates suggest that it will not be very far short of this total. On January 16th, 9,998,111 bales were ginned. After that date, in 1905, about 750,000 bales were ginned. Notwithstanding the difference in the crop the ginning in January, 1906, was on a scale little below that of the same month in 1905. In the south-west, according to Bradstreet, the ginning was actually on a heavier scale than a year ago. If as much is ginned during the rest of the season as was ginned in the balance of last season, the crop of 1905 growth should be about 10,750,000. In these figures, no account is taken of last year's crop unsold and carried over, estimated by some as high as 500,000 bales, so that it is pretty safe to say that the commercial crop of 1905-6 will exceed 10,500,000 bales. It is noteworthy that the National Ginners' Association estimate issued on November 18th, 1905, was a crop of 9,460,000 bales. It will be remembered that the 1904-5 crop totalled 13,565,585 bales.

Rubber Production.—In view of statements that are being made in prospectuses and elsewhere as to the cost of producing and marketing rubber, it may be interesting to note that the question as to what it costs to bring a pound of rubber to the market, that is to say from the moment it is tapped to the time it arrives at Colombo, is being discussed in Ceylon just now. The answer, of course, depends on many circumstances, but the opinion there would seem to be that, so far as Ceylon is concerned, the cost may be put at 48 cents per lb., which seems high. A liberal estimate of London charges, based on actual sales, gives 6¼ per cent., made up as follows:—Discount, 2½ per cent.; dock charges, about ¾ per cent.; freight, about ¾ per cent.; sale charges, including fire insurance, ½ per cent.; brokerage, ½ per cent.; loss in weight, 1¼ per cent. The Ceylon export of rubber in 1905 was roughly 75 tons, and the current year's imports are likely to show a large advance on these figures. The major portion of the 75 tons came to London. Germany got nearly 20,000 lbs., and Belgium and America each a little over 10,000 lbs. It may be noted in this connection that the first consignment of lace rubber to Hamburg was sold at 14 marks per kilo, or as near as possible 6·1¼d., about the highest price paid during the same week in London for biscuits or sheet. The brokers want sheet rubber, but there would seem to be considerable advantage in manufacturing rubber in the form of lace. In this shape it is ready for packing in 48 hours; no expensive machinery is required, no power to drive the engine as in the case of crêpe, which requires 8·9 horse-power, lace requiring only about 1-8th. The saving in labour, too, is great.

Home Industries and Foreign Trade.—We have now the principal figures relating to our foreign and colonial trade in the past year. As compared with 1904 the increase in our foreign trade is much larger in proportion than is that with British possessions. Exports to the former increased, as compared with 1904, from £188,773,170 to £216,443,079, or not far short of 15 per cent. The increase in our exports to British possessions was from £111,937,870 to £113,580,388, or less than 1½ per cent. In the case of Australia, our exports were actually smaller than in 1904—£23,489,760 as against £23,651,560 in 1904—our exports to Canada, on the other hand, showing an improvement of over 11 per cent. It is a little surprising that our exports to Egypt, notwithstanding the exceptional prosperity of that country, show a decrease of £430,381. The exports to Russia show very little change. They were £8,229,577 in 1904, and £8,170,871 last year, but our imports continue to increase—being £33,367,740 in 1905, as against £31,402,838 in 1904. Significant figures are those relating to Germany. The discrepancy in our export and import trade with nearly all foreign countries is enormous. Reference has been made to Russia. From Denmark, we imported products valued at £15,416,478, exporting to Denmark only £4,004,050 worth; from the Netherlands we took £35,481,791 worth, returning only £9,703,027; Belgium, the figures are £27,745,635, as against £10,069,381; for France, £53,097,453, as against £16,050,948; for Spain, £13,870,816, as against £4,248,513; for the United States, £115,683,254, as against £23,906,818; but with Germany the conditions are much more equal. We took from Germany products of the value of £35,826,161, and we sent to Germany goods valued at £29,711,521, an increase of over five and a-half millions sterling as compared with 1904. British India is the only country to which we sent more than we received, the exports being valued at £43,020,293, as against imports, £36,073,055.

American Competition.—In a letter to *The Times* of Saturday, Mr. O'Hara, the superintendent of Commercial Agencies, Department of Trade and Commerce, Ottawa, refers, in support of his contention that British trade suffers from the absence of commercial agents in Canada, to "the disparity of the United Kingdom's exports, as compared with a foreign rival," and says that nowhere is it so marked as in the case of Canada. "Canada's exports," writes Mr. O'Hara, "in round numbers, from Great Britain, in 1905 were £12,439,000, while from the United

States for the same period they were £32,000,000—more than double." A good deal more than double. Mr. O'Hara says that the necessity for "the appointment of British commercial agents in Canada to study Canada's needs, and point out to the British exporter the opportunities existing there, is abundantly evident on every hand." It is to be hoped and expected that before long these agents will be appointed, and they may do something towards checking the enormous growth of American exports to Canada by making British manufacturers better acquainted with Canadian wants. Note the figures as they relate to the chief competing centres:—

Exports to Canada of—

	1901, Dols.	1905. Dols.
Great Britain..	44,966,128 ..	62,195,000
France.... ..	5,503,177 ..	7,395,000
Germany......	6,667,959 ..	6,820,000
United States..	115,971,092 ..	160,000,000

It will be seen that, without exception, the United Kingdom has improved her position as compared with other countries. It is true that absolutely American imports have increased much more largely, but it must be remembered that whilst we benefit substantially from the preference given us by the Dominion this preference is a reduction in a tariff which operates heavily against manufactures while admitting raw materials free, or almost free of duty. Raw cotton, for example, from the United States goes in free, while cotton goods from England pay 25 per cent. to 35 per cent., less one-third of 25 per cent. to 35 per cent. Would commercial agents help us very much as against the United States? The best answer to that is to be found in the character of the principal American imports—fruit, hides and skins, metals, oils, provisions, seeds and roots, tobacco, vegetables, wood, cotton, breadstuffs. We do not grow cotton or tobacco, we could not on any terms supply food, or wood, or coffee, or hides. But the United States have these things in abundance; they are divided from the Dominion geographically only by an invisible line, and it is natural and inevitable that they should supply what the Canadians want of the articles named, and cannot supply themselves.

The Boot Industry.—At a conference of representatives of the largest retail boot-retailing concerns in the United Kingdom, held last week, it was agreed to raise the price of boots all round. For some time past the trade has been in a very unsatisfactory condition, and this has been due to a combination of adverse influences. In no trade is competition keener, and "cutting" more general. The advance in the cost of raw material, which has been very considerable—from 40 to 50 per cent.—has hitherto had little or no effect upon retail prices, from which the margin of profit has been largely removed. Now that the leading men have been induced by the press of circumstances to come to an agreement the public must look for a general increase in prices. They cannot complain, but they have the right to ask that the article sold shall be what it professes to be. At a trial before the Lord Chief Justice, which took place at the beginning of last year, it was proved in evidence, and indeed not denied by any witness, that in the manufacture of very cheap boots and shoes paper is used as part of the sole and heels for boots and shoes which are sold to the public as all leather. It is no sufficient answer that the public ought to know that all leather could not be sold at the price asked. There is no harm in putting paper into boots, if only the buyer knows that he is buying an article partly composed of paper, the mischief is where deceit is practised, and the purchaser misled. For a long time past some sellers have been anxious for a recognised trade mark that should give assurance that the boot is all leather, but trade jealousies have stood in the way.

Gas v. Electricity.—The struggle between gas and electricity is losing nothing of its keenness. The London County Council has just decided to restore the gas standards on Waterloo-bridge, which for the last three years has been lighted by electricity. All the London bridges will now be lighted by gas, except Westminster, which is lit half by electric light, and half by gas. The Council has been experimenting for some time past, and has now come to the conclusion that gas is the better illuminant, and is cheaper. Both Aldwych and Kingsway, where the lighting is exceptionally good, are lighted by incandescent gas, the lamps giving 660 candle-power each. Vauxhall-bridge is to be lit with similar lamps. The electric lighting companies are busy making improvements in their methods of street lighting, and are not at all disposed to acquiesce in the claims of their rival, which at the moment is making considerable headway in recovering lost business, and securing new. Gas cannot, of course, hope to compete successfully in places like theatres with electric light which has great advantages as compared with gas. It is handier to switch off and on, cooler, cleaner than gas, but these are advantages that apply rather to private than to public lighting. For streets, railway stations, and the like, it would seem that at the moment the incandescent system has the advantage both as to illuminating power and cost, but it does not necessarily follow that these advantages will be retained. It is not to be overlooked in this connection that the public authorities in Paris, Brussels, Berlin, and Vienna favour incandescent lighting. The question in London is complicated, so far as London is concerned, by the fact that many of the boroughs have sunk large sums in obtaining electric supply in their districts, and local authorities are naturally wishful of giving preferential treatment to their own undertakings, if it can be done with due regard to the interests of ratepayers.

The Motor Omnibus.—A good deal has been heard lately about inflammability and skidding, and

it will be necessary to minimise these incidents if the growth of the demand for these conveyances is not to be affected. Probably there will always be skidding more or less, but careful driving, and improvement in mechanical devices, may be expected to reduce its frequency. The fires are due to leakage which, except in the case of very serious collision, it ought to be possible to avoid by improvement in design. So with the noise when the omnibus is in movement. It is not unavoidable even with the present type of vehicle, and being avoidable by better management the public should be relieved of it.

CORRESPONDENCE.

"CASH ON DELIVERY" AND SMALL SHOP-KEEPERS.

I am often ordering publications and instruments either from publishers and makers in England or on the Continent, and must say that for anyone who does so more than occasionally, the "cash on delivery" system would be a boon. It is one of the few things that could with advantage be introduced in this country, specially if it is extended, as I have no doubt it will be when its convenience is recognised, throughout the Empire, as a preliminary to becoming international. Any transaction with the present system needs an exchange of letters that is a source of trouble, expense, and delay. One must first enquire for the price, the price must be quoted, the cheque or P.O. order sent, then the receipt sent and the goods dispatched, and the carriage paid on delivery. Four messages are exchanged, two of which must be in an envelope. With the "cash on delivery" system, one sends an order on a post-card, the goods arrive, are paid for at once, and the receipt delivered, without further delay or trouble.

Despite the solicitude of Mr. Lowther Bridger for the small shop-keeper, the latter is bound gradually to disappear, and, I may say, this is for his own benefit. One must have little commonsense indeed to order from town the small sundries one can get at the village shop. I do not see why, however, when what one requires cannot be found there, the General Post Office, in its praiseworthy endeavour to satisfy the country requirements, should not introduce a system presenting such advantages to quickness and facility of business transactions.

The time will come when the stores, in their colossal growth, will send ramifications in the surrounding small centres, and annihilate the small traders. It will be for their own benefit, as they are likely to be absorbed by the competing undertaking, which has all interest in having *employés* familiar with the country, its inhabitants, and their wants. The small retail dealer will so exchange his precarious living for a fixed salary, independence from local stagnation of trade, and increased freedom.

Another point which will help the change to take place is the fact that the small shopkeeper cannot afford to have the telephone. Why take the trouble to send a messenger to the next shop for some object which, nine times out of ten, is not to be found there, when at one's very desk (and nowadays one is even saved the work of ringing a call) at a moment's notice, the store's clerk can inform me of what he can supply, of prices, and other particulars?

M. E. J. GHEURY.

February 12, 1906.

GENERAL NOTES.

CONSULAR REPORTS.—Referring to a note in the *Journal* of December 8th (*see ante*, p. 98), on delay in the publication of Consular reports, a correspondent from Chicago, writes:—"I know of reports being constantly sent in by the Consul on matters which seem very important to those dealing in British goods out here, and yet have either never been heard of again, or else absolutely no notice taken of them by the merchants at home. It is marvellous how large looms New York in British eyes, and how small the rest of the States, and how insistent those at home are in ignoring the fact that they can both sell and buy cheaper by dealing direct with the trade centres, instead of through New York. I was at His Majesty's Consulate in Chicago, some months ago, and was there informed that they had suggested to the Home authorities that a sample room or small exhibition of British goods should be opened in connection with the office. I spoke of it to many of my merchant friends, and all of them were enthusiastic in praise of the idea, and yet, when I enquired how the scheme was getting on, was amazed to find that not a single British merchant had taken any notice of the proposal. Not even a letter had been received on the subject."

BASUTO PONIES.—In his report on Basutoland just issued (Cd. 2684), the Assistant Commissioner in the Quthing district, Mr. Barrett, says that the foals from Mr. Blunt's stud horse, "Farsang" (a Managhi im Sbeyel), look very promising, "with nice quality and substance, and are, in spite of rough winter coats, easily to be distinguished from the ordinary pony foals." If the natives generally, says Mr. Barrett, were able to take proper care of the mares they are sending to the various Arab stallions in Basutoland, a marked improvement in the quality of their ponies might be expected. "Their difficulty lies in the fact that their lower and more habitable parts of the country are much overstocked, and grazing is scarce, while if the mares are sent into the mountains to the summer pastures there is great risk

of their going wrong, owing to the numbers of inferior pony stallions running at large in that region." Efforts have been made to induce the chiefs of the country to order a general castration of the more useless of these stallions, but it is difficult to persuade native chiefs to enforce measures of public utility, and very little has hitherto been done in this direction.

British Trade with Servia.—Servia is in the almost unique position of having no export trade with the United Kingdom, or, to be exact, an export trade that, in 1904, only reached £100. The Belgrade correspondent of *The Times* says that the practical cessation of this trade is attributed by many in Servia to the rupture of diplomatic relations with Great Britain, consequent upon the murder of the late King and Queen, but this explanation is not supported by Mr. Vice-Consul Thesiger, who, in his report, just issued (No. 3529 Annual Series), makes the following observations:—"The exports from Servia to the United Kingdom in 1904 were valued at only £100, the values for the past three years being £10,467 in 1903, £44,445 in 1902, and £22,495 in 1901; up to which date they had been *nil.* The exports during these three years were composed entirely of meat, poultry, and eggs, which were despatched to the United Kingdom rather as an experiment, in the hopes of finding a steady and profitable market." This experiment failed, and chiefly because of the cost of carriage, and the want of organisation in Servia to ensure the level quality of the shipments. Hopes are, however, entertained of the experiments being continued, and Mr. Thesiger makes some interesting suggestions for furthering British trade with Servia.

Santos and Imports from Great Britain.—In his report on the trade of Santos for the years 1902-4, just published, Mr. Consul Mark says (Cd. 2682) that at one time there was scarcely an article in the long list he gives which was not imported chiefly from Great Britain. Now, out of 197 articles or groups enumerated, the United Kingdom is in a decided ascendancy in only 50; in 68 she still competes fairly successfully with other countries; whilst in the remaining 79 our trade has been practically appropriated by others. Mr. Mark contends that it is not creditable to the manufacturers of this country that in articles such as glass, certain classes of woollen and linen goods, silk, but particularly in china, glass, and paper, they should allow themselves to be ousted by their European rivals. The cause he believes lies in not sending the right kind of manufactures. What are sent are too good—*i.e.*, too expensive—too big, too heavy or unwieldy. In fact, too little attention is paid to tastes and fancies, and so others, who will take infinite pains to please in order to secure a market, take our place. "The South American markets are peculiar. What is wanted is something cheap and showy; it does not matter so much if it does not last, in fact, that is a positive recommendation in some cases. The British manufacturer insists on his own pattern, his own colours, weights, and measures, and thus loses customers. If there is a market for a lower class of goods, why not cater for it? It is after all but a matter of plant and capital. It is useless to say people will find out and appreciate the difference. They do not and do not want to. A cheap, showy article will be always generally preferred to expensive solidity."

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

February 21.—"The Fisheries of the North Sea." By Walter Garstang, M.A. Edwin Ray Lankester, M.A., LL.D., F.R.S., will preside.

February 28.—"London Traffic." By Captain G. S. C. Swinton (L.C.C.). Sir John Wolfe-Barry, K.C.B., LL.D., F.R.S., will preside.

March 7.—"Art in Painting and Photography." By J. C. Dollman, A.R.W.S. David Murray, R.A., will preside.

March 14.—"Imperial Organisation from a Business Point of View." By Geoffrey Drage. The Right Hon. Alfred Lyttelton, K.C., will preside.

March 21.—"Motor Boats." By Bernard B. Redwood, B.A. Sir John I. Thornycroft, LL.D., F.R.S., will preside.

Dates to be hereafter announced:—

"The Preparation of Oxygen from Liquid Air." By Monsieur Raoul Pictet.

"Submarine Signalling." By J. B. Millet.

"The General Supply of Electricity." By James N. Shoolbred, B.A., M.Inst.C.E.

"Industrial Russia." By Lucien Wolf.

"The Production and Collection of the Picture Postcard." By Frederic T. Corkett.

"Power Transmission and Coal Conservation." By Arthur J. Martin, Assoc.M.Inst.C.E.

"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By Professor Thomas Oliver, M.D., LL.D.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

March 15.—Dr. George A. Grierson, C.I.E., Ph.D., D.Lit., "The Languages of India and the Linguistic Survey."

April 26.—Colonel Sir Arthur Henry McMahon, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 6.—"Imperial Questions in the West Indies." By SIR NEVILE LUBBOCK, K.C.M.G.

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

FEBRUARY 20.—"Illuminated Manuscripts." By H. YATES THOMPSON, F.S.A. The HON. JOHN FORTESCUE, King's Librarian at Windsor Castle, will preside.

MARCH 20.—"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A. WILLIAM A. LINDSAY, K.C., Windsor Herald, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." Five Lectures.

LECTURES IV. AND V.—FEBRUARY 19 and 26. —Recent types of warships, British and Foreign—Battleships — Armoured and protected cruisers—Scouts—Torpedo boats and destroyers—Submarines.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.
March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.
April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.
May 14, 21, 28.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Sir William White, "Modern Warships." (Lecture IV.)
East India Association, Caxton Hall, Westminster, S.W. Mr. Shaikh Abdul Quadir, "Young India: Its Hopes and Aspirations."
British Architects, 9, Conduit-street, W., 8 p.m. Mr. Guy Dawber, "Furniture."
Medical, 11, Chandos-street, W., $8\frac{1}{2}$ p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., $4\frac{1}{2}$ p.m. Mr. M. L. Rouse, "The Bible Pedigree of the Nations of the World."
Asiatic, 22, Albemarle-street, W., 3 p.m.

TUESDAY, FEB. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. H. Yates Thompson, "Illuminated Manuscripts."
Hellenic, at the Rooms of the Society of Antiquaries, Burlington-house, W., 5 p.m.
Royal Institution, Albermarle-street, W., 5 p.m. Prof. W. Stirling, "Food and Nutrition." (Lecture III.)
Civil Engineers, 25, Great George-street, S.W., 8.m. 1. Mr. G. R. Jebb, "A Plea for Better Country Roads." 2 Mr. J. E. Blackwall, "Country Roads for Modern Traffic."
Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Messrs. A. L. Bowley and G. H. Wood, "Wages in the Engineering and Shipbuilding Trades in the Nineteenth Century."
Pathological, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.
Photographic, 66, Russell-square, W.C., 8 p.m. Mr. E. W. Harvey Piper, "Our English Chapter Houses."
Zoological, 3, Hanover-square, W., $8\frac{1}{2}$ p.m.
Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. General Booth, "Our Emigration Plans."

WEDNESDAY, FEB. 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Walter Garstang, "The Fisheries of the North Sea."
Meteorological, 70, Victoria-street, S.W., $7\frac{1}{2}$ p.m. 1. Mr. Edward Mawley, "Report on the Phenological Observations for 1905." 2. Mr. W. L. Dallas, "Discussion of the General Features of the Pressure and Wind Conditions over the Trades Monsoon Area." 3. Dr. William B. Newton, "The Dispersal or Prevention of Fogs."
Geological, Burlington-house, W., 8 p.m.
Microscopical, 20, Hanover-square, W., 8 p.m. Mr. H. Taverner, "An Improved Method of Taking Stereo-photo Micrographs and of Mounting the Prints."
British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, FEB. 22...Royal, Burlington-house, W., $4\frac{1}{2}$ p.m.
Antiquaries, Burlington-house, W., $8\frac{1}{2}$ p.m.
Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.
Royal Institution, Albermarle-street, W., 5 p.m. Mr. Henry B. Irving, "The English Stage in the Eighteenth Century." (Lecture II.)
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Claude W. Hill, "Crane Motors and Controllers."

FRIDAY, FEB. 23...Royal Institution, Albemarle-street, W., 9 p m. Prof. J. Oliver Arnold, "The Internal Architecture of Metals."
Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. C. H. Sumner, "The Graphical Determination of the Deflection of Beams."
Architectural Association, 18, Tufton-street, Westminster, S.W., $7\frac{1}{2}$ p.m. Mr. F. T. Baggallay, "Porches and Approaches."
Clinical, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.
Physical, Royal College of Science, South Kensington, S.W., 5 p.m.
Botanic, Inner Circle, Regent's-park, N.W., $3\frac{3}{4}$ p.m.

SATURDAY, FEB. 24 ... Royal Institution, Albemarle-street, W., 3 p.m. Mr. M. H. Spielmann, "George Frederick Watts as a Portrait Painter." (Lecture II.)

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FRIDAY, FEBRUARY 23, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 26, 8 p.m. (Cantor Lecture.) SIR WILLIAM WHITE, K.C.B., F.R.S., "Modern Warships." (Lecture V.)

WEDNESDAY, FEBRUARY 28, 8 p.m. (Ordinary Meeting.) Captain G. S. C. SWINTON, L.C.C., "London Traffic."

Further details of the Society's meetings will be found at the end of this number.

EXAMINATIONS.

The Society's Examinations will commence on Monday, April 2.

The last day for receiving applications from Local Committees is Wednesday, the 28th February, 1906, and after that date none will be received under any circumstances whatever. Application forms from the Provinces should therefore be posted not later than Tuesday, the 27th February. Committees may, however, close their entry lists at an earlier date, if found desirable.

Copies of the Programme for 1906, with full details, together with the questions for 1905, and reports by the Examiners, can be had, price 3d., on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, London, W.C.

The questions for the years 1900, 1902, 1903, and 1904 can also be obtained (price 3d. each year) on application as above.

CANTOR LECTURES.

On Monday evening, 19th inst., SIR WILLIAM WHITE, K.C.B., F.R.S., delivered the fourth lecture of his course on "Modern Warships."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday evening, February 20th; The HON. JOHN FORTESCUE, King's Librarian at Windsor Castle, in the chair. The paper read was on "Some Illuminated Manuscripts of Continental Europe," by H. YATES THOMPSON, F.S.A.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday evening, January 30; SEYMOUR LUCAS, R.A., in the chair.

The CHAIRMAN, in introducing Professor Thomson, said that, as a painter, he was deeply interested in the subject to be considered. Painters of the present day were somewhat spoiled, compared with their predecessors; their colours were beautifully prepared by the makers, and every attention paid to them, so that it was unnecessary for the painter to bother himself. But he had at home a handbook for artists, called "Polygraphice, or the Arts of Drawing, Engraving, Etching, Luminary Painting, Washing, Varnishing, Gilding, Colouring, Dyeing, Beautifying, and Perfuming, 1685," from which he learned that artists in those days had to manufacture their own colours. They were told what to do, and how necessary it was to be careful in mixing certain colours. One felt in reading the book, how very much painters owed to the chemist and the artists' colourman. If the colours of the present-day pictures deteriorated, he thought it was due to the fact that artists did not pay sufficient attention to the preparation of their pictures, one colour being plastered on the top of the other, in contra-distinction to the careful methods used by the Old Masters. Pictures were treated just in the same way that a water-colour artist treated a water-colour picture.

The paper read was—

THE CHEMISTRY OF ARTISTS' COLOURS IN RELATION TO THEIR COMPOSITION AND PERMANENCY.

By John M. Thomson, LL.D., F.R.S.

When asked by the Applied Art Section of the Society to read a paper on matters relating to the permanency of artists' colours, I found the subject such a wide one that it was impossible to deal with many of the questions involved in the time allotted to one paper. I must content myself, tberefore, this evening in putting before the members of the section only certain aspects of the subject, and trust that on some future occasion the matter may receive further attention. The question of the permanency of colours naturally divides itself into two parts: firstly, the question of permanency in the colours themselves, and, secondly, the effect of the different media with which they may be brought in contact in their use. It is with the first of these that I, as a chemist, will speak of this evening, and at the outset I should like the members of the section to regard the paper as one of an introductory character with the hope that the second portion may be treated of later by one more skilled than myself in its special bearings. Also as the changes relating to the permanency of colours are very many, should every colour be taken into consideration, I have determined to deal only with certain typical reactions, and to divide the consideration of the changes, as far as possible, into general groups.

The circumstances which chiefly influence the changes in pigment substances may be briefly enumerated under the following heads:—Action of light; action of heat as seen in volatilisation; molecular rearrangement in the substance itself; processes of oxidation and reduction; action of noxious gases as alkaline and acid vapours, sulphuration, &c.; action of solution; this latter being somewhat rare. The effect of the physical condition of the pigment should also be mentioned, as the colour and permanency differ considerably in pigments according to their state of aggregation.

For the purposes of examining the general effects of these various conditions, I propose this evening to group the colours in the following divisions, viz.:—Whites, Reds, Yellows, Greens, Blues, Browns; and it must be remembered that for the purposes of illustration in a short period of time such as is at our disposal, the colours must be submitted to more severe tests than those probably existing under natural conditions. When the question of time is taken into consideration, however, the conditions in both cases become equalised.

It is difficult to illustrate quickly the action of light on pigment substances, although the deleterious effects after long exposure are well known, especially in connection with some organic colouring matters. By placing, however, a sheet of paper coloured pink by one of these colours and covering a portion of it with a dark screen, you see after a few minutes exposure to the electric arc, that the portion left free by the star which has been cut in the screen has faded in a very marked degree to a pale almost colourless yellow. Not only do we find a fading of colour under the influence of light, but changes are also produced in which an actual change to a different colour takes place. I have here a sheet covered, as you see, with a yellow wash; this is not an organic colour, but mineral, a compound of tungsten. On holding it in the beam for a few minutes behind our screen you see that the portion where the light has acted has changed from the pale yellow to a bluey-grey colour. Of course both these colours have been subjected to conditions vastly more severe than what could happen in ordinary circumstances; but if we take the length of time colours in pictures may be exposed to sunshine and bright light, these conditions become comparable. In connection with the action of light on colours, the most important observations on this point are the experiments of Dr. Russell and Sir William Abney, detailed in their report to the Science and Art Department in 1888. Experiments have also been carried out by Professor O. N. Rood, Mr. W. Simpson, and Professor W. N. Hartley (British Association Reports, 1886).

The changes produced by heat on colours as might be expected, are more patent than those produced by light. They may be divided into two classes—(*a*) those which are purely intermolecular change within the pigment without change of composition; and (*b*) those in which a distinct alteration in the composition takes place. As an illustration of the first case, we may take the action of heat on iodine scarlet (HgI_2) a deep red colour, which on heating you see partially volatilises, the remainder on the sheet of paper becoming converted into a yellow variety. This variety is, however, so far as chemical analysis can

tell, of the same composition as the original red compound. On allowing the red variety to cool and then rubbing it with some hard substance you perceive that it passes back again into the red variety by mere friction. Another instance of change of colour without change of composition may be seen in ordinary vermilion (HgS). When this substance is obtained by precipitation it is black, as you observe when I add this solution of ammonium polysulphide to a solution of the mercury salt; but on boiling the black precipitate at first formed, it is gradually transformed into the brilliant red variety.

As might be expected, the cases of change of colour on heating with change of composition are much more numerous. These changes depend more particularly, either on the total decomposition of the pigment into its constituents, as may be seen in the decomposition of this green colour (Scheele's green), which is entirely decomposed into arsenious acid and metallic copper; or the conversion of one compound into another containing the same constituents, but differently arranged, as in this cobalt compound which you see, changes from red into a blue compound; or by the dehydration or loss of water from the pigment, as in the case of the darkening of ochres, &c.

Passing now to the various groups of pigments which I have chosen for illustration this evening, I think the first and most important groups are the whites. These colours occupy this position from the fact that one of the most important of the group is white lead, which is not only employed itself as a white colour, but is also used to a large extent in mixture with other colours, from the property which lead compounds particularly possess of saponifying with the vehicles with which pigments are generally mixed. Such lead pigments are especially acted on by sulphur vapours with the formation of black lead sulphide, which you see when I brush this wash of white lead with a sulphur compound. This property of lead compounds saponifying with the oil and forming a compound with it (linoleate of lead), although making the pigment work easily with the brush, may also exercise an effect in destroying the protective action of the oil as a coating, and so rendering the new compound formed more susceptible to the action of the sulphur vapours. In the case of white lead itself, it seems after a time to exercise some especial drying or hardening effect on the oil. This darkening action of sulphur vapours on lead compounds renders them dangerous when mixed with other colours containing sulphur, more especially when the mixture, probably stable at first, comes into contact with vapours capable of acting on the colour with which the lead compound has been mixed. I have here such a mixture of white lead and another colour containing sulphur. Under ordinary conditions they remain permanent, but if I bring in contact with them a wash of an akaline substance, you see that action is at once set up, and a darkening of the pigment takes place. It is fortunate that this darkening of the lead pigments may be counteracted to a certain extent by the process of oxidation, the lead sulphide being converted into the sulphate by strong oxidising agents. I have here a sheet coated with black lead sulphide, and you perceive by brushing with this oxidising agent, hydrogen peroxide, the black compound is at once changed into the white sulphate.

The permanent whites in regard to sulphuration are barium sulphate and oxide of zinc. The first because it is an extremely insoluble substance, withstanding the action of acids; the second, because it forms a white sulphide. Oxide of zinc, however, although undeteriorated by sulphur compounds and alkaline gases, is acted on by acid vapours.

There is another white, a compound of barium,—barium tungstate, which is of a distinctly permanent and fairly brilliant character, but may perhaps suffer the same objection to all whites, except the lead whites, namely, that it does not possess enough "body." I think however, that it is a white pigment deserving more attention from artists than it has hitherto received.

As the principal white pigment still used by artists is derived from lead and the best white obtained from it the basic carbonate, $2(PbCO_3), (PbOH)_2$, it may be of interest to note the different classes of carbonates to be met with, and their probable effect on other pigments and oils or vehicles. Carbonates are divided into the three classes, normal, basic, and acid. A normal carbonate is one in which the metallic oxide or base exactly corresponds to or neutralises the acid with which it is combined; a basic carbonate contains an excess of the base, and an acid carbonate a corresponding excess of the acid ingredient. Now, as both free alkalies and acids act on the materials used as vehicles in painting, it is evident that an alkaline

carbonate may commence a chemical action proving injurious to the painting; and conversely an acid carbonate may also initiate a change by the excess of acid in it combining with the free base in the alkaline carbonate. A second action to be kept in mind is, that many of the oils themselves become acid by exposure to the air, and the free acid so produced tending to combine with any free base existing in a pigment will naturally set up chemical action of an injurious kind. There is not time to-night to go into further chemical actions set up by changes in oils and other vehicles, but from the little I have been able to show you it is evident that for stability in a colour the more neutral or normal the pigment can be in its composition the better.

On turning to the red pigments we find that with the exception of those of organic origin, iodine scarlet and those containing lead, they may be regarded as practically stable substances. This arises from the fact that some good red colours can be obtained from the group of natural oxides of iron, of which Indian and venetian red (Fe_2O_3) may be taken as types. These do not yield to sulphuration, although they might show signs of failing under the influence of acid vapours. Under ordinary conditions properly prepared vermilion (HgS) ought to have fair permanency. Being a sulphide, it undergoes no change itself, and exhibits considerable resistance to chemical action. It has, however, a peculiar tendency after a time to become dull in colour, and therefore to change and lose tone considerably when in thin washes. This change is probably due to the return of the red variety of the pigment to the black or non-crystalline variety, a transference which I have already noticed at the commencement of my paper. Lead pigments should be avoided in mixing other colours with vermilion. From the expensive nature of good vermilion there is much temptation to adulterate with an inferior substance, antimony vermilion (Sb_2S_3), which, as you see in the experiment before you, can be readily obtained by boiling together antimony terchloride with a solution of sodium hyposulphite. Another danger in vermilion is when it contains free sulphur, an accident which may readily happen from the method of its preparation.

The other red pigments which must be regarded as of dubious permanency are, as you would expect, the lead colours, notably red lead. This substance is rapidly acted on by acid vapours, notably nitric acid, which at once turns it to a brown colour. Red lead itself is probably formed by the union of two other oxides of lead; by the action of the acid, as you see in the experiment before you, one of these oxides can be removed by an acid, leaving the other as a brown compound, the original brilliancy of the red having gone. Being a lead compound, it is also acted on by sulphur vapours, and cannot be regarded as a proper colour for the palette, however useful it may be for coarse outside work. Red orpiment or realgar (As_2S_2) must be regarded as a dangerous substance to use, as it destroys other colours.

With regard to the group of yellow colours, it is unfortunate that so many of the most brilliant of them and of the oranges are derived from lead compounds, and so are subject to the same criticism as the whites in relation to sulphuration. Thus, you see that these specimens of yellow and orange chromes being lead chromes are at once blackened and destroyed by a brush of this sulphur compound. It is true that for light chromes the strontium and barium chromates can be used. These are unchanged, so far as sulphuration is concerned; but the chromium compounds are unfortunately subject to changes produced by other gases, notably those producing reducing actions. In chromium compounds the metal may exist in a higher or in a lower state of oxidation, producing in each case compounds of different colours; in the lower or chromous condition these are green or almost colourless, in the higher or chromic condition, yellow and orange, sometimes passing to red. On brushing, therefore, one of these yellow washes made from a chromic compound, with sulphurous acid, you see it changes at once to the lower compound, giving a green colour. This susceptibility to reduction explains the changes they undergo when in contact with other colours of organic origin. They also change under the influence of alkalies.

Undoubtedly under many conditions one of the most permanent of yellow colours is pure cadmium yellow (CdS). This substance is not acted upon by sulphuration or affected by the action of weak alkalies or acids, and it may be mixed with other pure colours, such as pure ultramarine. Permanent, however, as we might suppose this colour, it is dangerous to mix with blue copper pigments, as chemical action seems to be set up and a blacking action to be produced. This may be seen in the mixture I

have here of a copper blue with cadmium sulphide, which you see at once blackens when the sheet is blown upon by these acid vapours. In thin washes cadmium yellow is also subject to change into the less coloured sulphate by oxidation. I have here such a wash of pale cadmium the half of which has been subjected to the action of hydrogen peroxide, and you see that very considerable deterioration in the colour has taken place. Here the cadmium yellow has been subjected to very severe conditions; but the deterioration of pale washes of the colour in water colours exposed to light has been noticed, and probably can be attributed to this oxidation. Of the yellow colours, the most permanent, like the reds, are to be found in the ochres or earths. The yellows differ from the red ochres merely in being hydrated oxides, their lighter colour depending on their state of hydration or their dilution with pure white clay. On heating they become darker in colour, and, being hydrated oxides, they are liable to be acted on by acid vapours, but otherwise may be regarded as durable colours under normal conditions. The least permanent of the common yellow pigments are the lakes; king's yellow; and zinc chromate.

The green colours used as pigments are derived chiefly from compounds of copper and chromium. Of these the chromium compounds, except perhaps in the case of pure malachite, must be regarded as probably the most durable. The copper-greens are subject to rapid change by sulphuration, becoming darkened under its action, and they are also liable to change under the influence of gaseous alkalies, becoming of a blue shade. This change can be easily illustrated to you by this experiment, in which you see the wash of a copper-green at once turned to blue by the action of ammonia. In the same way it is blackened by hydrogen sulphide.

One of the more prominent greens, apart from chromium greens which must be regarded as the most permanent, is terre verte, a natural mineral containing iron. Such compounds, although stable under ordinary conditions, are liable to change in colour from the conversion of the iron from the lower or "ferrous" into the higher or "ferric" condition. Such a change, showing the influence of the ferrous form on a pigment, is seen in the following experiment:—I have here a solution of iron sulphite which I now filter into a solution of caustic potash, taking care to keep the solution during its passage out of contact with the surrounding air. The solid body formed by the interaction is, as you see, practically colourless, but if turned out and exposed to air upon this plate it rapidly turns first to a light then to a dark green, finally becoming coated at the edges with a brown colour. This shows very distinctly the influence of the presence of such iron in a pigment, and the change in colour likely to be produced on the original substance by oxidation. Fortunately, this change is slower on the naturally-formed bodies.

The green pigments formed by mixtures of the oxides of cobalt and zinc (Rimmann's green) fixed at high temperatures must be regarded as permanent colours.

The blue pigments in common use by artists are to be found in the groups of colours yielded by the compounds of cobalt, the natural ultramarine or *lapis lazuli;* the iron compounds of cyanogen; and in organic colours as indigo. Of these the cobalt blues, known as smalts, are distinctly the most permanent, as they are artificial silicates or glasses in a finely ground condition, and from their insolubility little likely to be acted upon under ordinary circumstances. They are certainly immune to the action of sulphur compounds, but being silicates free from calcium salts they are likely to be acted upon by acids. Mechanical division also produces a change in colour in the smalts. In natural ultramarine we have a pigment which may be regarded as permanent unless brought in contact with acid vapours, even weak vegetable acids exercising a very marked effect upon it. I have a wash of the colour on this paper, and you see that brushing it with weak acid at once affects the colour, and causes deterioration. It is therefore dangerous to use with other pigments likely to have an acid reaction.

Of the Prussian blues there are at least three different modifications—one a soluble variety, the second an insoluble variety, and the third variety closely allied to the first, termed Turnbull's or Gmelin's blue. The one employed by artists is the insoluble variety. Generally speaking, the insoluble variety may be regarded as a fairly good colour, the principal deteriorating agent being alkaline vapours which decompose the colour, leaving a dirty brown, due to the formation of oxides of iron produced by the breaking up of the double cyanide. This change you see at once on the sample that I have here. It may be produced by lime and even the weakest alkalies. The

colour therefore cannot be used for fresco painting where it would come in contact with plaster. Thin washes of the colour are also deteriorated by light, becoming converted into faded brown, but if the exposure has not been of long duration a return to the original blue colour may be produced by placing the faded colour in the dark for some time. That pigments such as the various forms of prussian blue should be risky to use as colours may be seen by one or two experiments in connection with the formation of these double cyanides, which depend on the differing nature of the iron salts employed. If we bring together the yellow prussiate of potash with a salt of iron in what I have already described to you as the "ferric condition," you observe that we obtain a precipitate of the true dark blue colour; but if I use a second iron salt which is in the "ferrous" condition, you see that the precipitate is by no means homogeneous; is of a mixed light blue colour, and has a marked tendency to pass into a dark blue under exposure to the air. Indeed, if I take a salt of iron entirely in the "ferrous" condition, as I have it in this solution of iron sulphite, and bring that in contact with the yellow prussiate of potash out of contact of air, you perceive that the substance formed here has no blue colour at all, but is perfectly white. On pouring this out on a plate, however, it rapidly becomes oxidised, and converted into prussian blue. These changes show the complexity of the reactions in the formation of these colours; and are due to the varying nature of the compounds which may be formed, unless the proper salts of iron are employed in their preparation.

Although I had not the intention this evening of dealing in detail with organic colours, there is one so well known as a blue colour, namely indigo, that I should like to say a word concerning it. This colour is now obtained in two modifications, the natural and the artificial varieties. It is a deep blue of good body, and a very powerful and transparent colour. Although possessing apparently such a strong blue colour, the pigment is not strictly permanent. In thin washes it is fugitive, especially when mixed with white lead, and it is markedly acted on by oxidising agents either direct or indirect. Taking this wash which you see is of considerable intensity, I brush over it an oxidising agent, and at once it changes to a pale yellow tint, and if I use more of the oxidising body you see that the colour entirely disappears. It is also acted upon by reducing agents, being converted into a colourless body, white indigo. This substance, however, by mere exposure to air, rapidly returns to the blue colour.

With regard to the brown pigments in general use, more especially the mineral browns, they may be regarded as permanent colours. They are composed for the most part of natural earths or natural minerals, containing the metals manganese, iron, or cobalt, and are, therefore, little acted on by light or sulphur vapours. As they are oxides, the most important chemical change in regard to them is that of reduction, which is especially seen in the case of the manganese brown. This wash of manganese brown which I now show you, becomes at once colourless on brushing with sulphurous acid. This colour should also be used with caution in connection with vegetable and animal lakes. Burnt sienna and the umbers being oxides of iron of varying composition may all be regarded as permanent browns, except that they also undergo partial change on reduction, although perhaps not to so marked an extent as in the manganese compounds.

The time at our disposal permits me to touch but briefly on colours from organic sources, and these I must deal with from a general point of view.

Except in the case of one or two special pigments such as indigo, and carthamine red from the safflower, which may be regarded more as a dye than a pigment, the most of the organic colours are used in the form of lakes. The lakes are generally formed by precipitating the colouring matter by means of some oxide, generally those of tin or aluminium. This being done by the action of an alkaline body, the changes such colouring matters readily undergo are seen even in their preparation; as the quantity of free alkali present produces considerable variety in the shade of colour. The lakes vary greatly in durability, and of them perhaps the madder bodies may be regarded as the most durable. Those derived from such colours as the logwood extracts have little permanence. When aluminium salts are used for the formation of the lake, the oxide of that metal being unacted on by hydrogen sulphide renders the lake slightly more permanent; that is apart from any action which might take place in the colour itself. Lakes formed with the oxides of tin or of lead are easily destroyed by that gas, and quickly lose their brilliancy of colour. Very marked changes are also

produced on these organic colours by alkaline and acid vapours. I have here a wash of one of the red lakes and you see that even very dilute quantities of ammonia and of hydrochloric acid gases blown upon the paper at once show most marked changes in the colour. The general result of such changes is to produce with alkaline vapours a darker, and with acid vapours a lighter colour, but the changes are very various and by no means regular.

There is one group of organic colours derived from coal tar which are quite inadmissible as artists' pigments. It might therefore be imagined that there was no necessity to mention them here; but the brilliancy and tinctorial power that some of these colours possess might tempt some to make artificial pigments, by mixing these brilliant dyes with colourless mineral substances, such as silica, alumina, chalk, or barium sulphates in fact, to make with them pigments somewhat akin to lakes. Most of these colours are affected both by acid and alkaline vapours, in a manner similar to that which we have seen in the lake colours.

In drawing conclusions with regard to the general behaviour of pigments under the various actions which I enumerated at the commencement of my paper and of which we have had experimental illustration, I have arranged the different common pigments in the following Table according to their chemical relationships, but keeping in each group the arrangement of colours I have adopted throughout my paper.

TABLE I. — CLASSIFICATION OF SOME MORE COMMON PIGMENTS ACCORDING TO THEIR CHEMICAL RELATIONSHIPS.

(a) Elements.

	Gold	
	Silver	
Black	Graphite	
	Ivory black	
	Lamp black	

(b) Oxides.

White	Zinc white......	ZnO.
Red	Burnt sienna ..	Chiefly Fe_2O_3.
	Indian red	
	Venetian red ..	
Green	Chromium green	Cr_2O_3
	Cobalt green ..	CoO, x ZnO.
Blue	Cobalt blue	CoO, x Al_2O_3.
	Cœrulean	CoO, x SnO_2.
Brown	Burnt umber....	Fe_2O_3, MnO_2.

(c) Hydrates.

Yellow	Yellow ochre ..	Fe_2O_3 x H_2O.
	Raw Sienna	Mixed hydrated oxides of Fe and Mm
	Raw umber	
Green	Viridian..........	$Cr_2O_3 2H_2O$.

(d) Sulphides.

Yellow	Vermilion	HgS.
	Cadmium yellow	Cd.S.
	King's yellow ..	As_2S_3.
Blue ..	Ultramarines....	Mixtures of Si, Al, Na, O and S.

(e) Carbonates.

White	Flake white	$2PbCO_3$, $Pb(OH)_2$
	Whitening	$CaCO_3$.
Green	Malachite	$CuCO_3$, $Cu(OH)_2$.
Blue ..	Chessylite	$2CuCo_3$, $Cu(OH)_2$

(f) Silicates.

Green ..	Terre verte	Silicate of Fe, Mg, and K.
Blue ..	Smalt	Silicate of Co and K.

(g) Chromates.

Red ..	Chrome red	$PbCrO_4$, PbO.
Yellow	Baryta yellow ..	$BaCrO_4$.
	Chrome yellow ..	$PbCrO_4$.
	Strontia yellow..	$SrCrO_4$.
	Zinc chromate ..	$ZnCrO_4$.

(h) Non-classified Inorganic Pigments.

White	Baryta white	$BaSO_4$.
	Tungstate white	$BaWO_4$.
Yellow	Aureolin	$Co_2K_6(NO_2)_{12}, 2H_2O$.
	Naples yellow ..	Pb.Sb.O.

(i) Some Organic Pigment Substances.

Red ..	Carmines	Cochineal beetle.
	Crimson lakes ..	
	Madder reds	Alizarin ..$C_{14}H_8O_4$. Purpurin..$C_{14}H_8O_5$.
Yellow	Indian yellow	Magnesium euxanthate. $C_{19}H_{16}M_8O_{11}, 5H_2O$.
	Yellow lake	Quercitin.
	Madder yellow.	
Green ..	Sap green.	
Blue ..	Indigo	Blue. $C_{16}H_{10}N_2O_2$.
	Prussian blue ..	$\overset{III}{Fe_4}(\overset{IV}{FeC_6N_6})_3$.
	Sepia	Cuttle fish.

Taking such an arrangement we find the following general points:—In group (*a*) the black pigments mentioned are permanent, and one of the elementary metals namely, gold, is little liable to chemical action. The element silver is, however, readily acted on by sulphur compounds, and drawings with this metal are often altered in hue.

Group (*b*) contains the oxides. These are generally stable bodies not acted on by air, moisture, or hydrogen sulphide, unless they contain metals yielding black sulphides. Such oxides, however, do not appear in the group. The chief danger with this group is from reducing agents. They may also be regarded as practically inert when mixed with other pigments.

The hydrates (*c*), as they contain water, may change in tone by the loss of that substance, and as they have not been prepared at the high temperatures to which the oxides have been subjected, they cannot be regarded as in quite so stable a condition. They are, however, safe colours for all ordinary purposes.

The sulphides group (*d*), as we have seen, are dangerous, especially in mixtures with other colours, often giving up their sulphur and deteriorating the other pigment. Some of them also undergo a change of colour by intermolecular change within themselves. They are also liable to oxidising actions, being gradually converted into sulphates. There is also the danger that in the preparation of some of these sulphides free sulphur may exist, which acts more readily and directly on other colours mixed with them.

The carbonates group (*e*), of which instances are given, if they change at all, do so chiefly by the formation of black sulphides in the cases where the pigments contain the metals lead and copper.

The silicates group (*f*) are very strong pigments, and are little liable to change when derived from natural sources. Artificially made silicates used as pigments, might undergo a little solution in water, as they are not of the harder variety of silicates like calcium silicates, but any action of this kind is likely to be very slight. If properly prepared, silicates might prove very durable pigments, and I have always been surprised that more experiments have not been made with regard to the manufacture of pigment substances in the form of silicates.

The chromates group (*g*) are substances in a fairly high state of oxidation so that they will be acted on most readily by reducing agents, varying the colour from the brilliant yellows and oranges to a green hue, due to the formation of lower compounds of chromium.

In my paper this evening it has been quite impossible to deal with the question of vehicles, which exercise no doubt very considerable protective action on the pigment, and assist in retarding deleterious actions. I have only been able to put before you some of the most important changes which the substances undergo when brought as simple washes under the conditions which I mentioned at the beginning of the evening as affecting such changes. I am in hopes that someone more versed than I am in varnishes and vehicles may be induced to contribute a future paper to the Section on that particular branch of the subject. My object has been to try and induce artists to become more acquainted with the chemical nature and qualities of the pigments they are using, and like the old masters to possess themselves of some knowledge of the chemical reactions and changes taking place when pigments are mixed with one another.

The manufacture of pigments has become a trade, and I fear in some cases made up pigments are sold when the pure substance is not insisted upon by the purchaser. Pure pigments can be obtained, but if the artist is so careless as not to satisfy himself that the article he wants is perfectly pure the supply of the faked substance will continue. If the artist, in his desire to obtain some startling or brilliant effect of colouring, persists in ignoring the imperfect means by which this result is obtained, and buys, irrespective of its true composition, some mixed up colour which will quickly and temporarily suit his aim, then his pictures will undoubtedly deteriorate.

It is a great pity that there is not some more systematic and accurate method adopted in the naming of colours. Several pigments are known and sold under the same name, and an artist buying a colour under that name is ignorant of its difference in composition from a second one having the same name. As an instance we may take the case of "emerald green," a name applied to two distinct and different substances yielding a green colour. Some important body of artists should insist that one name only should be given to each colour, and that manufacturers should supply the particular chemical substance known under that name and that only.

APPENDIX.

TABLE II.—Pigments liable to change under the influence of Sulphuretted Hydrogen, Air, and Moisture.

White	Cremnitz white.
	Flake white.
	Pearl white.
Red	Iodine scarlet.
	Purple red.
	Red lead.
Orange	Orange chrome.
Yellow	Chrome yellow.
	Mineral yellow.
	Naples yellow.
	Turbith mineral.
Green	Emerald green.
	Mountain green.
	Scheele's green.
	Verdigris.
Blue	Prussian blue.
	Antwerp blue.

TABLE III.—Pigments less liable to change under the influence of Sulphuretted Hydrogen, Air, or Moisture.

White	Barium tungstate.
	Constant white.
	Tin white.
	Zinc white.
Red	Indian red.
	Madder lakes
	Red ochre
	Vermilion
Orange	Burnt sienna.
	Orange vermilion.
Yellow	Aureolin
	Barium chromate.
	Platinum yellow
	Raw sienna.
	Yellow ochre.
	Zinc chromate.
Green	Chrome greens.
	Cobalt greens.
Blue	Smalt.
	Thenard's blue.
	Ultramarine.
Brown	Burnt umber
	Manganese brown.
	Raw umber.
	Sepia
	Vandyke browns.
Black	Graphite.
	Indian ink.
	Ivory black.
	Lamp black.

TABLE IV.—Pigments liable to deterioration when in contact with White Lead.

Red	Carmine.
	Cochineal.
	Iodine scarlet.
Orange	Golden antimony sulphide.
	Orange orpiment.
Yellow	Gamboge.
	Indian yellow.
	King's yellow.
	Yellow orpiment.
Green	Sap green.

TABLE V.—Pigments which are little affected by heat, and may be employed when the material has to stand the fire.

White	Barium white.
	Tin white.
	Zinc white.
Red	Indian red.
	Red ochre.
	Venetian red.
Orange	Burnt ochre.
	Burnt sienna.
Yellow	Antimony yellow.
	Naples yellow.
Green	Chrome greens.
	Cobalt green.
Blue	Smalt and Royal blue.
	Ultramarine.
Brown	Burnt umber.
	Manganese brown.
Black	Graphite.
	Mineral black.

TABLE VI.—Classification of some more Common Pigments According to Stability.

Class I. Permanent.	Class II. Moderately permanent.	Class III. Fugitive and liable to change.
	White.	
Barium white.	Flake white.	
Zinc white.		
	Red.	
Indian red.	Madder red.	Carmine.
Red ochre.	Vermilion.	Crimson lake.
Venetian red.		Iodine scarlet.
		Scarlet lake.
	Yellow.	
Raw sienna.	Aureolin.	King's yellow.
Yellow ochre.	Barium yellow.	Yellow lakes.
	Cadium yellow.	Zinc chromate
	Chrome yellow.	
	Indian yellow.	
	Naples yellow.	
	Strontium yellow.	

TABLE VI. (*continued*).

	Green.	
Chromium green.	Emerald green.	Green lake.
Cobalt green.	Madder green.	Sap green.
Green ultramarine.	Malachite.	Verdigris.
	Terre verte.	
	Blue.	
Cobalt blue.	Prussian blue.	Indigo.
Cœruleum.		
Smalt.		
Ultramarine (lapis lazuli).		
	Brown.	
Burnt sienna.	Vandyke brown (mineral).	Vandyke brown (organic).
Cappagh brown.		
Umbers.		Other organic browns.
	Black.	
Charcoal black.		Bitumen black.
Graphite.		
Ivory black.		
Lamp black.		

TABLE VII.—Two Specimen Palettes (1) Oil Colours, (2) Water Colours, which may be regarded as Permanent, except under exceptional circumstances.

Oil Colours.	Water Colours.
White.	
Flake white.	Zinc white.
Red.	
Carmine (madder).	Carmine (madder).
Light red (ochre).	Light red (ochre).
Vermilion.	Iron red (red ochre).
Yellow.	
Aureolin.	Aureolin.
Cadmium yellow.	Cadmium yellow.
Yellow ochre.	Yellow ochre.
Green.	
Viridian.	Viridian.

TABLE VII. (*continued*).

Blue.	
Cobalt blue.	Cobalt blue.
Ultramarine (true).	Ultramarine (true).
Brown.	
Cappagh brown.	Mars brown.
Raw umber.	Raw umber.
Black.	
Ivory black.	Indian ink.

TABLE VIII.—Some of the more important Pigment Substances used by Painters in the Early Centuries.

White	Chalk.
	White lead.
Red	Cinnabar.
	Dragon's blood.
	Hæmatite.
	Red lead.
	Red ochres.
Yellow	Orpiment.
	Realgar.
	Saffron.
	Yellow ochres.
Green	Copper frits.
	Malachite.
	Terre-verte.
	Verdigris.
Blue	Azzurite.
	Cobalt frits.
	Ultramarine (lapis lazuli).
Black	Vine black.
	Lamp black.
Other colours..	Brazil-wood (braxillium).
	Cochineal.
	Juice of violets.
	Kermes.
	Lac or gum of ivy.

TABLE IX.—Some of the more Common Pigments, with the Names and Formulæ of the Chemical Substances from which they are derived.

Classified according to Groups of Colours.

White	Chinese white	Zinc oxide	ZnO.
	Constant white	Barium sulphate	$BaSO_4$.
		Barium tungstate	$BaWO_4$.
	Cremnitz white; Flake white	White lead	$[2PbCO_3, Pb(OH)_2]$.
	Pearl white	Bismuth oxychloride	$[2(BiCl_3. Bi_2O_3). H_2O]$.
		Basic nitrate of bismuth	$[Bi(NO_3)_3. 2Bi(OH)_3]$.
	Tin white	Tin binoxide	SnO_2.
Red ..	Iodine scarlet	Mercuric iodide	HgI_2.
	Purple red	Basic mercury chromate	$(HgCrO_4\text{-}HgO.)$
	Realgar	Arsenic sulphide	As_2S_2.
	Red lead	Lead oxides	$[3(PbO). PbO_2.]$.
	Red ochre	Ferric oxide	Fe_2O_3.
	Vermilion	Mercuric sulphide	HgS.

TABLE IX. *(continued)*.

Orange	Orange chrome	Basic lead chromate	$PbCrO_4$ PbO.
Yellow	Aureolin		$K_6Co_2(NO_2)_{12}, 3H_2O$.
	Cadmium yellow	Cadmium sulphide	CdS.
	Chrome yellow	Lead chromate	$PbCrO_4$.
	King's yellow	Arsenic sulphide	As_2S_3.
	Lemon yellow	Berium chromate	$BaCrO_4$.
		Strontium chromate	$SrCrO_4$.
	Mosaic gold	Tin bisulphide	SnS_2.
	Naples yellow	Oxides of lead and antimony	$PbO+Sb_2O_5$.
	Platinum yellow	Platino-chloride of potassium	$(PtCl_4.\ 2KCl)$.
	Turner's yellow	Lead oxychloride	$(PbCl_2.\ 7PbO.)$.
	Turbith mineral	Basic mercury sulphate	$(HgSO_4.\ 2HgO.)$.
	Yellow ochre	Ferric hydrate and clay	$[(2Fe_2O_3.\ 3H_2O).+Clay]$.
	Zinc chrome	Zinc chromate	$ZnCrO_4$.
Green	Chrome green (viridian)	Chromic oxide	Cr_2O_3.
	Cobalt or Rinmans' green	Oxides of cobalt and zinc	$(CoO+ZnO.)$.
	Emerald green	Acetate and arsenite of copper	$[Cu(C_2H_3O_2)_2.\ CuHAsO_3]$.
	Mountain green	Green malachite	$[CuCO_3.\ Cu(OH)_2]$
	Scheele's green	Copper arsenite	$CuHAsO_3$.
	Terraverte	Clay coloured with iron and other oxides	
	Verdigris	Basic copper acetate	$[Cu(C_2H_3O_2)_2.\ CuO.\ 6H_2O]$.
Blue	Insoluble Prussian blue	Ferric ferrocyanide	Fe_4Fcy_3.
	Indigo		$2(C_8H_5N_5O_2)$.
	Mountain blue	Blue malachite	$[2(CuCO_3).\ Cu(OH)_2]$.
	Smalt	Cobalt and potassium silicate	CoK_2SiO_4.
	Soluble Prussian blue	Potassio ferric ferrocyanide	$K_2Fe_2Fcy_2$.
	Ultramarine	Silicate of aluminium, and sodium with sodium sulphide	$Na_2Al_2Si_2O_8Na_2S_2$.
Brown	Burnt sienna	Clays coloured with oxides of iron and manganese	
	Burnt umber		
	Manganese brown	Manganese dioxide	MnO_2.
	Vandyke brown	Ferric oxide	
Black	Black lead	Plumbago or graphite	Carbon + ash.
	Mineral black	Impure graphite	
	Blue black	Charcoal from vine twigs	Artificial varieties of charcoal, with greater or less impurities.
		Cocoa nut and peach stones	
	Diamond black	Impure lamp black	
	Ivory black	Charred bones	
	Lamp black	Soot from resins or tar	
	Spanish black	Charcoal from cork	

DISCUSSION.

The CHAIRMAN said that the author's opening remarks made him feel very sad, but he recovered somewhat when Professor Thomson proceeded to say that if painters kept to a simple palette they had little to fear. It was discouraging to think that flake white, which was a charming body to work with, was subject to such terrible changes. He had tried to use zinc white, which was rather a thin substance, but had never taken to it kindly. The one ray of hope was the simple palette, and if a man had the art in him he could paint a very great work with twelve colours. Professor Thomson had referred to painters running round to the chemist to be supplied with a particular tint they required. A great many artists nowadays wanted all their colours ready prepared for them, which was a great mistake; they should themselves prepare the different shades out of the simple earths. He further asked whether he was right in assuming the author's opinion was that the Old Masters painted chiefly with minerals, and that that accounted largely for the permanency of their work? and also if Professor Thomson could state what colours Van Eyck used, because although his pictures were painted over 400 years ago, the white seemed to have stood very well indeed?

The Hon. JOHN COLLIER asked whether, when the author spoke of indigo, he referred to artificial or real indigo, and whether the former was more permanent than the latter? also if he would be kind enough to give a little information on the use of oils,

varnishes, resins, and so on, which, he believed, had a considerable influence on the stability of paintings. He (Mr. Collier) gathered from the author's remarks that, although the ordinary flake white could not be considered absolutely permanent, he did not say that painters should not use it, because that would be very awkward, as nearly all pictures were painted with flake white. He thought it was the tendency of oil paintings to get a little more yellow with age.

Mr. J. C. Dollman, referring to Professor Thomson's classification of emerald green in his tables, said that it was generally regarded by painters as being a very unstable colour, but he understood the author to say the contrary was the fact.

Madame Louisa Starr Canziani presumed that Professor Thomson meant, when he said that emerald green and cadmium turned black, not the oxide of chromium, but the pigment which was generally sold as emerald green. She would also like to ask whether, after preparing the canvas with the usual foundation white—which is white lead, it is safe to paint the picture with zinc white, or whether the two whites would combine chemically in a deleterious manner, and what their action one upon another would be.

Mr. J. D. Batten, in referring to the subject of the sale of colours incorrectly named, said that a good deal of it was due to carelessness, though unfortunately part of it was intentional. In reading Professor Church's book, he found there were some colours which were natural and some which were artificial, but closely resembled the former, and were frequently sold under the same name. For instance, Venetian reds and Indian reds were natural earths, but there were also artificially prepared iron oxides of some kind which chemically closely resembled them and were sold under the same names. That naturally was a cause of great perplexity to artists who attempted to make any sort of observation on the permanence of colours, and a great many artists did take great pains in that way. Another instance, and a even more serious one, was that Professor Church stated in his book that colours which were commonly sold under the name of madder were not the product of the madder root, but coal tar products which were manufactured so as to be practically identical chemically with those derived from the madder root. He believed he was right in saying that they were not only the same on analysis, but had the same spectrum. In spite of that it appeared to him a most unfortunate thing that the two pigments should be sold under the same name. It was entirely beside the mark to say that the artificial pigment was better and more permanent, because if that were so, artists ought to be informed of the nature of the pigment sold them, so that they might use the artificial paint and set aside the inferior natural product. But as far as vegetable madder was concerned, it had a very good record behind it. Dr. W. J. Russell, F.R.S., examined some colours derived from early Egyptian paintings, which he thought he was correct in saying were believed to be painted about 4,000 B.C. Among the colours was a pink colour. He forgot whether the body was chalk or gypsum, but it was a white earth of some sort, tinged with something pink, and, on examination, it gave the spectrum of madder. He did not know how much the paint had faded, but he thought it was very wonderful that any pink colour was left at all, and that 6,000 years was a very good record for a vegetable colour to last. When a chemical identity had been established between a natural and an artificially prepared substance, that was not the conclusion of the whole matter. In medicine a drug could be prepared artificially which was chemically identical with one derived from a plant, but its action on the human body was not identical in many cases. That fact was also known in other crafts besides the medical craft, Mr. William Burton, the potter, having pointed out to him recently some Persian tiles on which there was a red called Rhodian (a natural earth stained with an iron oxide) which, when fired, would stand the same heat as the cobalts and copper colours, but when the same red was made chemically absolutely identical with the other, if subjected to the same heat, it burnt away; there was something that slipped out between the natural products and the artificially compounded article of the same name. Until artists' colourmen were more explicit in the naming of the colours they issued, painters who tried to make experiments were doing so under quite unnecessary difficulties.

Mr. Walter Reid said that Professor Thomson had almost exhausted the chemical part of the subject in regard to the actual reagents; but as he (the speaker) had gone into the technical part of the subject by means of experiments extending over a great number of years, and had made and used many hundreds of tons of paint, he knew exactly, from the experience of about a quarter of a century, what would and what would not stand. He wished to criticise in the first place the author's method of carrying out the experiments. It was impossible to take one point only and eliminate the others, because the permanency of a pigment was dependent upon the substances with which it came in contact, whether gases, such as air, or the substances upon which the paint was applied, or the medium with which the paint was mixed, the most important of all. He should like to ask the author what medium he had used. Except where water was used, there was some medium in contact with the paint which might have an action. Again, the colours, even when applied to white paper, would probably, in some cases, be acted on by the agents used for bleaching the paper. It was impossible to eliminate the action of the substances in contact with the pigment, or the action of the pigments on each other, or the action of the

atmosphere upon them. One of the most important suggestions the author had made was that silicates should be used as colours. Pigments used in porcelain painting would stand for centuries, and if anyone liked to spend the money he could get absolutely permanent pigments, such as were used in porcelain painting. He must, however, take them as they were. He could not do what the porcelain painter did, who, for instance, took a brown pigment which, when fired, came out a beautiful green. The artists must also make sure that the pigment was pure silicate. One very important blue had been omitted from the list, which had the test of very many centuries behind it—namely, silicate of copper. Those who had examined the mummies, and the ornaments upon them, in the British Museum would have noticed a beautiful blue enamel, something like a turquoise. That was also used as a pigment, the manufacture of which had been handed down to them by Vitruvius. It could be made perfectly well in the present day, but colour manufacturers did not make it because the demand was for cheaper products. It was first made in Alexandria, and its method of manufacture was to grind sand with flowers of sulphur, then add the coarse fillings of Cyprian copper, roll it into balls and dry it. It was then placed in an earthen vessel and afterwards into a furnace. The result was that a silicate of copper was produced, and although the paint had been exposed to the air for many centuries it was absolutely permanent. It was quite true that the ancients did use organic colours—for instance, madder and purple. The method of manufacture of the latter, as described by Vitruvius, was to beat the shells that supplied the colours up with iron rods, strain the liquid, dry it and mix it with honey. Madder was also used, but he would remind them that the action of light had been excluded from the paintings referred to. He did not think madder would have stood if it had been exposed to light for a number of years. The author's remarks with regard to black paint were very important indeed. Ordinary linseed oil was used nowadays in most cases as the medium for oil paints, but if that oil was exposed to the air for three or four years it began to oxidise still further. The first product was an elastic substance, but on further oxidation it became liquid. In 1891 he exhibited at the Society of Arts some of the acid liquid substance produced in that way, simply by exposure to the air. When, therefore, a pigment was being tested which was to be mixed with oil, it must not be tested in contact with the substance which was the first oxidisation product of the linseed oil, but with the second. It was a very curious fact that some of the blacks which had been found to work well with oil were substances which contained some basic constituent For instance, ivory black was, or should be, calcined ivory, and contained earthy matter which neutralised the acid substance produced by the oil. Vitruvius recommended as a black that the lees of wine should be taken and calcined, and a very fine black was then obtained which had a blueish tint, and which must undoubtedly contain a good deal of carbonate of potash, Blacks which were successful contained something which was basic, and he was very glad to see that an unsuccessful one like bitumen was omitted from the author's list, although unfortunately it was on many old paintings. The black colour of bitumen was beautiful and permanent, had stood for thousands of years, and had not bleached, but if it was mixed with linseed oil, as soon as the oil began to liquefy they ran together. He had a painting of Sir Thomas Lawrence's at home in which the distances between the little masses of paint that had run together were over one quarter of an inch. He had not had it restored because he liked to keep it as a specimen of what injury could result from using imperfect pigments. The necessity for some ingredient of a basic nature was one of the reasons why most of the colours that contained lead in an uncombined state, or in a state where it was simply combined with a weak acid, like carbonic acid, remained in good condition, the lead acting upon the acid products that were produced subsequently by the oxidation of the oil. The liquid was absorbed by the lead as it was produced. In a substance like sulphate of baryta no such action took place, and such a paint would not stand. He was afraid that in his remarks he had brought in the question of the medium, but he did not see how the pigments could be judged without some reference to the substances with which they were mixed. He hoped the author later on would devote his attention to the media as well as to the colours, and favour the members with some interesting experiments on that subject also. He noticed that yellow ochre was stated in the paper to be permanent, but he had ascertained from experiments extending over twenty years that it darkened very considerably if exposed for about ten years in contact with linseed oil. A question has been raised with regard to emerald green. The true name for the green made from the chromium oxide was chrome-green, and it should be so called. Bnt there were two chrome-greens. One was produced by precipitation, and was easily acted upon by many of the re-agents which the author had shown; but the other, which was made by calcining the chromate of potash, was absolutely permanent. It might be exposed for an indefinite period with oil with no effect. Many of the reactions were due to the state of sub-division. Reference had been made to that point in the course of the discussion, Venetian red being instanced. Artificial Venetian red was in very much finer state of sub-division than what was called the natural Venetian red. As a matter of fact there were no natural Venetian red at all; it was a calcined ochre. The lightest natural oxide of iron was much too dark to give the tint that was required, but where the ochre was calcined the required colour was obtained. Manganese was quite permanent in its natural state, but an artificially precipitated oxide of manganese was less stable. It was very much

like alumina. In its natural form this occurred as a ruby or sapphire, which were almost unchangeable. But if it was precipitated from a liquid it was not at all permanent; it could be dissolved by a number of agents, which would not act at all on the ruby or sapphire. In conclusion he thanked the author very sincerely for his exceedingly clear and interesting paper.

Professor THOMSON replied that one of the reasons why he kept vehicles out of the paper was that he thought a person more technically versed on that branch of the subject than he himself was, should deal with it. There was no doubt they influenced the stability of paintings. With regard to the naming of colours, he would point out that salesmen used so many names for the pigments that it was sometimes difficult to find out which one was meant. There were at present two distinct pigments called "emerald green," one chromium oxide, which within reasonable limits was a stable colour, the other aceto-arsenite of copper, which was unstable. This latter would change under certain circumstances with sulphides. It was an unfortunate thing that people who sold colours seemed to be allowed to put any name they liked on them. In reply to the Chairman, he said indigo might be regarded as a permanent colour, except under extreme oxidation. He referred to the natural indigo, but he could not say whether the artificial was more permanent than the real. Replying to Madame Canziani, he said that if the first coat was allowed to dry, although some action might be produced it would take a very long time. If the paints were moist they would mix together and chemical action would be induced. Flake white might be considered safer in oils, because it was bound by the oil, but, as a chemist, he could not say it was a safe colour. Pictures in which that colour was excessively used gradually got yellow.

The CHAIRMAN, in proposing a hearty vote of thanks to Professor Thomson for his most able and interesting paper, said he quite agreed with Mr. Batten that artists' colourmen should not put labels on colours which were other than they were supposed to be. Painters had quite enough to do in thinking out their subjects and in overcoming the difficulties connected with the production of good pictures; and if artists' colourmen would therefore put a label on the colours stating what pigments they should not be mixed with, and whether they were permanent or not permanent, they would be helping the poor artist very much indeed.

The resolution of thanks having been carried unanimously,

Professor THOMSON, in reply, thanked the audience for the very kind manner in which they had received his remarks, and expressed the hope that other questions relating to the subject which he himself had been unable to consider might be dealt with by others at some future date.

TWELFTH ORDINARY MEETING.

Wednesday, February 21st, 1906; EDWIN RAY LANKESTER, M.A., LL.D., F.R.S., Director of the Natural History Department, British Museum, in the chair.

The following candidates were proposed for election as members of the Society:—

Boughton, George, Woodlands, Ryde, Isle of Wight.
Hugo, Dirk de Vos, M.B., Worcester, Cape Colony, South Africa.
James, E. Haughton, Forton, Chard, Somerset.
Ling, Ernest E. L., 60, Wall-street, New York City, U.S.A.
Mukherji, Harendra Krishna, M.A., 54, Sankaripara-road, Bhawanipur, Calcutta, India.
Oliver, William Henry, P.O. Box 27, Luipaards Vlei, Transvaal, South Africa, and 10, Avondale-road, Truro, Cornwall.
Riley, George, Effra Works, South Lambeth-road, S.W.
Robinson, Wilfrid Harold, 44, Bedford-row, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Basden, Albert Edward, Lieutenant Governor's Office, P.O. Box 438, Pretoria, Transvaal, South Africa.
Boyce, Framroze Hormusji, near Fire Brigade Station, Fort, Bombay, India.
Busteed, Brigadier-Surgeon Henry Elmsley, C.I.E., M.D., care of Messrs. H. S. King and Co., 9, Pall-mall, S.W.
Chacon, Francisco, Spanish Royal Naval Commission, 65 and 66, Chancery-lane, W.C.
Coutts, Ernest Gray, Indus Bridge at Kushalgarh, N.W. Province, India.
McNaught, James, Lumding, A.B. Railway, Assam, India.
Terry, Rev. Charles John, M.A., 15, Hyde-gardens, Eastbourne.

The CHAIRMAN, in introducing the reader of the paper, said he had great pleasure in taking the chair at the meeting since it recalled to his mind events which occurred 22 years ago in which he took an active part. In 1883 a great Fisheries Exhibition was held at South Kensington, and it then occurred to himself and some of his friends that it was very important there should exist in England means for the scientific investigation of the life history of fishes, and they hoped to obtain some of the surplus funds of that Exhibition when it closed for the purpose of founding such an institution. He called a meeting o scientific men, and men interested in fishes, which was held in the rooms of the Royal Society, and as a result the Marine Biological Association of the United Kingdom was established at the beginning of 1884. A month or two afterwards he read a paper at the Society of Arts on the importance of having such a laboratory, the chair being taken by Mr. Edward Beckwith, who was at the time Prime Warden of the Fishmongers' Company, an arrange-

ment due to the kindness and interest in the whole matter of his old friend, the Secretary, Sir Henry Wood. The result was that the Fishmongers' Company took a great interest in the Marine Biological Association, gave £2,000 to its funds, and ever since had given £400 a year towards maintaining its laboratory and paying the expenses of the researches carried on there. Within a short time after the commencement he had collected as much as £12,000. The Government gave £5,000, and a grant of £500 a year at first, an amount which was subsequently increased to £1,000 owing to the active intervention and goodwill of Mr. Chamberlain, who was not then a member of the Government, but was able to persuade the Chancellor of the Exchequer (Mr. Goschen), to grant the money. He thought it only right to point out that those who originally helped the foundation of the Laboratory at Plymouth and the operations of the Marine Biological Association were the Liberal Government, of which Sir Lyon Playfair, afterwards Lord Playfair, was an active member; they took a special interest in the attempt to apply scientific knowledge to a great national industry. The Laboratory at Plymouth, which was completed and opened in 1888, had carried on its work for eighteen years, and a great deal of valuable and useful work had been done there. It had a very devoted staff, and there was a committee in London directing the operations of the Laboratory, which had given an immense amount of trouble to its organisation and business on patriotic grounds and for the love of science. No kind of assistance or even good-will had ever been received by the Marine Biological Association from the paid officials connected with fishery matters in this country. The intention of the foundation was that means of scientific investigation should be provided in the Laboratory for persons whom those officials might nominate, and pay to investigate certain problems. Four or five year ago, a proposition emanating from the Scandinavian powers, was taken up in this country by Sir John Murray and others to undertake an investigation of the North Sea, with a view to understanding more clearly the movements and breeding of fishes therein. An International Conference was called, and eventually the English Government agreed to take part in the investigation. The Treasury, largely through the influence of a gentleman who was always greatly interested in the Marine Biological Association, and whose loss they all deeply regretted, Mr. Stephen Spring Rice, asked the Association to undertake certain investigations on behalf of the Government, which had been proposed by the International Conference, and to the carrying out of which the Government had pledged itself. The Council of the Association, after due deliberation, undertook to superintend and to carry out the investigations as far as possible, and a large sum of money was placed at their disposal for the purpose, It was necessary to employ a steamship, specially fitted for rough work in the North Sea, and a number of investigators. Mr. Garstang, who had already done valuable work at Plymouth, and in connection with the various inquiries conducted by the Marine Biological Association, was appointed as the chief naturalist in charge of the investigations undertaken, and he proposed to give in his paper some account of what had been done during the three years which had elapsed. Personally, he (Professor Lankester) was deeply interested in the subject, and felt especially pleased at being present to hear of the fruition of the movement which he suggested to the Society twenty-one years ago. The work then undertaken, for the carrying out of which generous financial support had been forthcoming, was still being carried on, but very important results had been achieved, and the necessary scientific investigation of the life and history of fishes was being accomplished. Nevertheless their work had been hindered and threatened by the jealousy of highly-salaried Government servants who were unable to do the work achieved by the Association or to understand its importance. The Association relied on the judgment of its work by the leaders of the fishery industry and the acknowledged leaders of science.

The paper read was—

THE FISHERIES OF THE NORTH SEA AND THE BEARINGS OF RECENT INVESTIGATIONS UPON THE PROBLEMS OF SUPPLY.

By Walter Garstang, M.A.,

Naturalist in Charge of the Fishery Investigations of the Marine Biological Association; late Fellow of Lincoln College, Oxford.

Twenty-one years ago, in May, 1885, Professor Lankester addressed the Society, which has honoured me by its invitation to-night, upon "The Value of a Marine Laboratory to the Development and Regulation of our Sea Fisheries," and announced the intention of the newly-formed Marine Biological Association to establish a laboratory at Plymouth for the purpose of advancing that knowledge of the conditions of marine life which is universally admitted to be indispensable for the successful treatment of sea-fishery problems. After giving examples of the many important questions which could not be answered without fuller and more accurate knowledge, Professor Lankester summed up the situation in the following words:—"In fact, we know exceedingly little about the minute details of the life of marine animals, and if we wish to deal with sea fisheries like rational men, we must find out these minute details, and gradually apply the knowledge so gained."

In the interval which has elapsed, the work of finding out those "minute details" has

made constant, if quiet progress, not only at Plymouth, but at other laboratories with similar objects both at home and abroad. We have learned to distinguish the eggs, larvæ, and young of the various species of fishes, with few exceptions, from one another; the spawning seasons, relative fecundity, size at first maturity, rate of growth, the characteristics of local races, the food and habits of many species, have been extensively investigated; and last, if not least, we have surmounted the main difficulties in artificially rearing the delicate fry of sea-fishes both from pelagic and demersal eggs.

It is true that the field within which this knowledge could be applied has hitherto been exceedingly limited, owing to the fact that, until the inauguration of the international investigations, opportunities for investigating the deep sea fishing grounds were exceedingly rare. The practical object of learning to distinguish the various fish eggs and larvæ was to enable us to map out their distribution in the sea, and so to trace out the connection between the shoals of young fish and the spawning grounds from which they were derived. But the wide surveys necessary for this purpose were a matter, as Professor Herdman has expressed it, of "ships and men and work at sea," and sea-going vessels of sufficient size were beyond the normal resources of our scientific institutions.

Fortunately the international character of the fishery problems of the North Sea has led the Governments of all the States which surround it to co-operate, in the interest of the fisheries, in a serious effort to explore the resources of this sea. Three years' work has already been accomplished, interim reports on various branches of the investigations have made their appearance, and the broad outlines of results are beginning to take shape, as the first years' experiences become confirmed or modified by the results of subsequent experiment and observation.

Now the great practical problems which in the opinion of the International Council outweigh all others in importance are these two:—

1. The nature and causes of the migrations of the cod and herring, as bearing on the fluctuations in the yield of these fisheries, and

2. The question of over-fishing, especially in the case of flat fish.

The first of these problems is one of particular interest to the Scandinavian countries.

"All historical accounts speak of years which were specially rich and of years when the fish were absent, and though of recent years the entire technical equipment of apparatus, boats, &c., has considerably improved, the absence of the shoals still strikes deep into the conditions of the fishing people." (Hjort, 1905.) The excessive character of these fluctuations is easily seen upon reference to statistics of the cod fisheries of Lofoten and Finmark, and of the herring fisheries both of Norway and Sweden.

The Lofoten fishery is a spring fishery carried on during the spawning season of the cod, which at that time approaches the coast in dense shoals. During the summer the fish almost entirely disappear from this region, while a new fishery develops off the coast of Finmark, to the north of the spawning grounds. At this time and place large quantities of medium-sized fish as well as large spent fish are taken. The fish at this time are actively feeding, and undertake great migrations in the region between Spitzbergen and Norway in pursuit of their favourite prey, the arctic "Lodde" (*Mallotus villosus*).

Prior to the commencement of the international investigations Scandinavian naturalists had begun to suspect that a close relation existed between the varying migrations of these and other fishes and the periodic changes of ocean currents. As the parallel study of the physics and biology of the sea constitutes the fundamental plan of the international investigations, it is worthy of note that the existence of this relation in several areas is no longer a matter of mere hypothesis. Off Iceland and the Shetlands in the summer months, off the northern coast of Norway and in the Skagerrak in autumn, an east-going current of relatively warm salt water has been detected, which is weakened in intensity or replaced by cold currents in an opposite direction a few months later. The period of expansion of the east-going current has been observed iu each area to be associated with considerable migrations of the fish population.

At Iceland in spring the Danish investigators have found that the cod spawn only on the southern side of the island, where the water is warmed by its proximity to the Atlantic stream. The cold water north and east of Iceland is destitute of spawning cod and of cod eggs at this time. But as the summer advances the Atlantic (Irminger) current expands round the western and then round the northern side of the island, carrying the shoals of cod and cod-fry with it in its course. The summer fisheries on the north coast of Iceland

now begin, and follow the fishes on their passage eastwards.

In the Barents Sea the Russian and Norwegian investigators have clearly demonstrated that the vast immigrations of cod and haddock into this region in late autumn is caused by an annual expansion of the Atlantic stream which flows past North Cape. In spring this flooding ceases, the Barents Sea is invaded by Arctic water, and the fish return towards the Norwegian Sea.

Professor Otto Pettersson, the Swedish hydrographer, attributes all these phenomena, with many others, to the influence of one dominant factor throughout, viz., a summer expansion or overflow of the great Atlantic whirlpool which circulates round the Sargasso Sea. The full effects of this periodic flood would naturally manifest themselves earlier in the western than in the eastern and northern parts of the area under discussion.

Whether the periodicity of the phenomena is attributable to this or to other agencies is an important matter which the hydrographers will doubtless settle in good time; it is sufficient at present to note that important relations do exist between the reproduction and migrations of fish and hydrographic changes.

But it must not be imagined that a theory of this kind is arrived at by research steamers going out in special search of Atlantic eddies or schools of fish. The first and most essential thing is to collect exact and comparable data over wide areas, and it is to secure this object that the international programme has been drawn up. The general scheme of investigation may be outlined as follows :—

The North Sea and adjacent waters which influence it, including the Baltic Sea, English Channel, and the Norwegian Sea as far west as Iceland, were divided up into districts for exploration by the vessels of the participating countries, on the general principle that each country would undertake the investigation of those sections of the entire area which bordered upon its own territory. Once a quarter each vessel was to make a hydrographic cruise along predetermined lines in the months of February, May, August, and November, for the purpose of sampling the physical and biological characters of the waters of each region, including the temperature and salinity of the water at successive depths, and the nature and relative abundance of the floating organisms present at each station. The intervals between these cruises were to be occupied with trawling and other investigations bearing upon the distribution of the various stages of fish and their migrations, reproduction, and rate of growth, as well as upon the bottom fauna and flora in general.

In accordance with this programme several of the investigation steamers have been largely occupied in making collections of floating eggs and fry at different seasons and at different depths over the area under investigation. Much time and labour are required to work over the collections brought ashore, and it is not until the results have been charted that correct ideas can be formed as to the locality of the spawning grounds for particular fishes and the direction taken by the drifting eggs and fry after the spawning is over.

It is also of great importance to know the sizes and ages of the fish frequenting particular grounds, in order that comparisons may be made between different localities, and the movements of the fish at successive a gestraced from one ground to another.

The determination of age is being investigated partly by Petersen's method of extensive measurements at a given date, and partly by the study of otoliths and scales. The migrations are being investigated by the liberation of labelled fish.

As the various branches of work are being carried out in each area by each steamer on comparable lines, it will be understood that a broad basis is being laid for ultimate conclusions.

In the case of the herring the existence of different local races possessing special structural peculiarities has long been recognised as a result of Professor Heincke's investigations, though the precise geographical limits of the distribution of each race are far from certain.

Some of these races, however, inhabit the salter waters and others the more brackish waters during the chief fishing seasons, and a relation of their migrations to annual fluctuations in the hydrographical conditions has been clearly established in the case of the Norwegian spring herring fishery by Hjort, and, in the case of the Swedish fisheries, by Pettersson. It is therefore exceedingly probable that a similar relation exists between the southward trend of the herring fisheries along the east coasts of Scotland and England and the southward eddy of Atlantic water which is the chief hydrographic feature of this region. This point is being investigated by the Scottish and English steamers, together with the question whether the shoals which appear at

successive points along the coast are racially identical or not.

Before leaving the subject of the cod and herring, it may be pointed out that, although the elucidation of their life-history is considered to be of special economical importance, yet the results cannot be restricted to those species. The net which collects cod-eggs collects haddock and other eggs also, if they are present, and the whole material is being worked out. Consequently, there is every probability that the investigations will incidentally provide an explanation of those "floods" of small haddock and other species which our trawlers experience from time to time.

Possibly an increase of knowledge on these points may seem to some to be more of an intellectual luxury than an economical necessity. But it may be pointed out that the problem of the supply of haddock differs only in degree from that of plaice, while the treatment of the latter problem has been rendered particularly difficult owing to the lack of scientific information acquired before the species showed critical signs of serious over-fishing.

We may now approach the investigations which are in progress on the latter problem.

The over-fishing question is essentially a trawling problem: what is the effect of trawling, as carried on at present, on the supply of fish?

This involves questions of the reproduction, migrations and growth of the fish affected. It is with regard to the progress of knowledge on these points that I propose to deal more especially on this occasion, while drawing attention to the bearings of the facts on various suggested methods of increasing the supply. I propose also to restrict my remarks in the main to the plaice, as the species of most importance from a practical standpoint.

It should be borne in mind that prior to these investigations, there was no exact knowledge applicable to the fishing grounds in general as to the distribution of the various sizes of plaice, their migrations, or their growth. We possessed merely isolated observations which had in many cases played an important part in developing our knowledge, but were insufficient as a basis for general conclusions. A great mass of information has now been acquired as a result of the work of the various steamers in different parts of the area. Much of the material, however, has to be worked up in the various laboratories before it is available for general information, and I shall therefore deal to-night almost exclusively with the observations made by the staff of the Marine Biological Association and the work of their steamer *Huxley*.

The difference in the size of plaice on different fishing grounds, is an essential feature of the distribution of this species. We have now records of over 750 hauls of the large commercial trawl, in which practically every fish of every species was measured, making a total which exceeds a quarter of a million. These records refer to most of the important trawling grounds in the southern part of the North Sea, but they are naturally most complete in the strictly English area west of 3° E. They show clearly what are the dominant sizes on particular grounds, and what changes take place at successive seasons. In the Southern or Flemish Bight of the North Sea, for example, the great majority of plaice are below 30 cm. (12 inches) in length at all seasons of the year, whereas on the Dogger Bank there are practically no plaice below that limit.

To get a general idea of the distribution of the different sizes and of the chief seasonal changes, I have extracted a number of our records showing the catch of plaice per hour at different trawling stations, distinguishing the number of those above 30 cm. in length from the number of those below. These have been placed upon two charts, one for each half of the year. For each half-year the highest figure has been chosen in those cases where there were many hauls in the same locality.

In each chart high numbers (from 100 to 1,800 per hour) prevail only on the eastern side of the North Sea, and in that region the number of small plaice is greatly in excess of the number of large in both seasons. A contour line drawn to separate these high numbers from the remainder approximately defines on each chart the chief nursery grounds of the plaice, *i.e.*, the localities where the greatest number of small plaice are reared. By this means we see that the area occupied by the small fish shifts seawards during the summer. In the spring the contour line practically coincides with the depth line of 20 metres (11 fathoms), except off Texel, where it extends further out. In the autumn the contour lies further seawards at every point, and corresponds in the main with a depth line of about 15 fathoms, except in the latitude of Esbjerg, where it bulges seawards as far as 6° E., where the

depth reaches 25 or 26 fathoms. The charts suggest a general emigration seawards on the part of the small plaice during the summer months, which attains its greatest dimensions off the Horn Reef Grounds in the north and off Texel in the south.

Direct experiment by means of marked plaice has confirmed these conclusions in the clearest manner. The Danish marking experiments on the Horn Reef grounds in the spring of 1903 showed a distinct north-westward emigration from month to month throughout the summer and early autumn; and the English experiments of 1902-3 showed similar results in the area of the Flemish Bight.

But it is remarkable to notice how slight is the effect produced by these migrating shoals upon the population of the Dogger Bank and other grounds in the centre of the area. The small plaice can be traced from the eastern grounds as far as the Tail of the Dogger in the autumn, but in greatly reduced numbers; the southern part of the Bank is scarcely affected. On the other hand, the arrival of small immigrants (though in small numbers) is indicated by the trawling results during the spring period. It would appear that the Dogger Bank lies out of the main track of the autumn emigrations and receives its supply of small plaice in the following spring as a result of a further redistribution of the fish.

This is rendered still more probable when the results of the marking experiments during the autumn months are considered. German experiments on the Great Fisher Bank, and an experiment of our own on the Horn Reef Outer Ground in autumn both showed a marked reversal during the winter months in the general direction of the migration, viz., southwards, instead of northwards, the majority of the fish recaptured showing a general tendency towards the Eastern Grounds again.

Similarly, in the western part of the North Sea our marking experiments in the autumn of 1902 and 1903 showed a preponderating southward movement of the fishes, in marked contrast to the offshore trend in summer. These results have been shown with even greater clearness by experiments carried out between the Dogger Bank and the English coast in the autumn of 1904.

These southward migrations in winter affect the large mature plaice on the northern grounds immediately before the spawning season. They may, therefore, be termed "spawning migrations" in contradistinction to the offshore movements in summer, which have every character of a "feeding migration." But the fact that the winter migrations also affect the immature fish on the offshore grounds shows that the movement is to be traced to external influences rather than to any instinct specially associated with the gravid condition.

The life-history of the plaice will be traceable in still greater detail when the results of the investigations on the relation of size to age in different areas are available, as it will then be possible to convert our figures showing the distribution of the different size-groups into corresponding figures for the various age-groups. These investigations are being carried out mainly by the method introduced by Dr. Reibisch of Kiel, which depends on the annual periodicity of the rings of growth shown by the otoliths or ear-stones. By counting the white rings we get the age of the fish in years.

We have ourselves collected the otoliths of nearly 9,000 plaice from different localities, and my colleague, Dr. Wallace, has worked over the greater number of these with very clear and definite results. The accuracy of the method is shown by the close agreement between Dr. Wallace's results and those obtained by our Dutch and German colleagues in areas which have been investigated by both of us independently.

Disregarding small local differences, it is found that the plaice in the southern part of the North Sea grows on an average about 7 cm. ($2\frac{3}{4}$ inches) a year in length during the first three years of life.

The observed differences in the rate of growth on the different grounds are inconsiderable during these years. The three-year old fishes begin their fourth year in March at an average length of about 21 cm. ($8\frac{1}{4}$ inches) off the Dutch coast. The average size at this age is a little less on the Eastern Grounds, and still less along the English coast from Flamborough Head to the Thames. During the next year the average growth in the Flemish Bight is almost exactly 5 cm. (2 inches). This figure results from the examination of over 2,000 plaice belonging to the fourth and fifth yearly groups which were collected during May and September along a continuous line of trawlings from Texel to the Leman Ground. The growth of the three-year-old fishes from May to September was 3·4 cm. (not quite $1\frac{1}{2}$ inches).

On the other hand, in the western part of the English Channel the growth of the young plaice has been found to be much higher. In Devonshire waters the plaice has an average

length of 27 cm. (10½ inches) at least at the beginning of its fourth year, an excess of 6 cm. (2½ inches) over the average length of the fish at the same age in the southern part of the North Sea. These results agree closely with the average rate of growth shown by marked plaice of corresponding ages.

After the fourth year the rate of growth varies greatly in different localities, being greater on the offshore grounds than on the coastal banks.

This was shown in a striking manner in the course of 1904 by transplanting a considerable number of young marked plaice (1,100) from the inshore grouuds to the Dogger Bank during April and May. The average size of the recaptured fishes increased steadily and at a rapid rate from month to month, until at the close of a complete year the fish showed an average increase in length amounting to 15 cm. (6 inches)—*i. e.*, three times the normal growth on the coastal banks.

Now the differences between the lengths of an 8-inch, 10-inch, and 14-inch plaice are but a feeble index of their relative weight and value, since the weight increases as the cube of the length. The relation of weight to length for plaice from the Eastern Grounds has been determined with great precision by the Board of Agriculture and Fisheries, and from their results we can see that a so-called 8-inch plaice weighs on an average 3·4 oz., a 10-inch plaice 6·4 oz., and a 14-inch plaice 17·5 oz. Thus the small fish, which scarcely double their weight in the course of a year under natural conditions on the coastal grounds, increased it five-fold by transplantation to the Dogger Bank in the course of 1904. The reason for the difference is to be sought in the far greater reserves of plaice food on the Dogger Bank than on the coastal grounds, owing chiefly to the great difference in the density of the plaice population on the two areas.

Extensive investigations on the food of fishes have been carried out by my colleague, Mr. Todd, who finds that out of 1,000 plaice examined in 1903, 78 per cent. were feeding on mollusks. These consisted almost entirely of bivalves, which abound upon the Dogger Bank. The closest competitors with the plaice for this class of food are the haddock and dab, both of which species occur upon the Bank, often in great numbers, though their tastes are by no means so specialised as those of the plaice. Nevertheless 64 per cent. of the haddock, and 60 per cent. of the dabs examined in 1903, were feeding upon mollusks, in addition to other food.

In the course of 1906, a further experiment in transplantation to the Dogger Bank was carried out, in order to see whether similar results would be yielded in a different year. Several months have still to elapse before we shall be able to ascertain the full year's growth, but up to the present it has proceeded at a rate which indicates a probable increment of about 10 or 11 cm. (4 or 4½ inches) at the end of the year. This falls short of the previous year's results, though the increase in length and weight is twice as great as the normal increase on the coastal grounds.

The cause of this difference in growth can only be finally settled by new experiments; but we have every reason to believe that it was of an exceptional character, viz., an invasion of the Bank during the past summer by extraordinary shoals of young haddock. We were ourselves struck by the great abundance of these fish, but the evidence of experienced fishermen is of greater value as an indication of the exceptional character of the phenomenon, and the fact has been clearly established by one of the Grimsby skippers, who fill up records of their catches for our information. The first entry occurs in his logbook for the early part of May, 1905, when he was fishing on the Dogger Bank, and runs: "Tons of very small fish to be put overboard, such as haddocks and whitings; it is many a year since I saw so many very small fish on the Dogger Bank." Similar entries occur in his books at later dates, and the fish were still abundant when the *Huxley* fished upon the Bank in October last.

In view of the fact that the haddock feed, to a large extent, on the same food as plaice (as many as 500 small *Solens* have been taken from the stomach of a single haddock), there is little room for doubt as to the cause of the slower growth-rate of plaice on the Dogger Bank during 1905 as compared with the previous year. On the other hand, the exceptional nature of the cause renders it probable that the high growth-rate shown in 1904 may be expected to recur in normal years.

The question naturally suggests itself whether it is not a practicable thing to carry out on a commercial scale for profit what we have done on an experimental scale for knowledge. The transplantation of young plaice into the inner lagoons of the Limfjord in Denmark has been carried out on a commercial scale every year since 1892. The experiments which we have

made on the Dogger Bank are the exact counterpart of those which were undertaken by Dr. Petersen in the Limfjord in 1895, with the object of finding out the conditions under which the enterprise might be developed most successfully. In each case the initiative to such work on a commercial scale has been taken by practical men, in Denmark by Messrs. Mikkelsen and Mehlsen, and in England by Mr. Frank Barrett of Grimsby, who, in 1902, at the Annual Conference of the National Sea Fisheries' Protection Association, advocated the transplantation of small plaice to the relatively exhausted offshore fishing grounds, as a means of increasing the supply. Our work entirely supports the feasibility of Mr. Barrett's proposals. Under the conditions which have been laid down in our official report, there is every reason to expect a profitable return from such an enterprise.

Since our report was published, many additional recaptures of the transplanted fish have been reported, and a careful revision of my original forecast shows that the transplantation of 1,000,000 small plaice may be expected to yield a return of at least £3,000 within 18 months.

The relatively small numbers dealt with in our experiments fail, I am aware, to carry conviction to many minds. I do not, however, claim more at present than that a case has been made out for at least one experiment on a commercial scale, in order that the fishermen may have an opportunity of judging the results for themselves.

Dr. Petersen agrees with me in suggesting that the first experiments might well be carried out by means of a small fleet of Danish plaice-cutters, which carry wells, under the convoy of an English steamer. It is highly improbable that the cost would exceed £1,000. In 1903 the Danes transplanted 200,000 plaice into Thisted and Skive Broads at a cost of 12s. 8d. per 1,000, which is equivalent to an expenditure of £635 per million.

The reason for employing Danish boats, in the first instance, to catch the fish is because the trawl is far more likely to injure the fish than the seine employed by the Danish fishermen. According to Dr. Petersen, the men who are employed to fish for the purpose of transplantation in Denmark are dissatisfied unless they catch at least 4,000 plaice per haul of the seine, and the cutters are stated to catch easily 50,000 plaice each in one day. It would thus require ten cutters to catch one million fish in two days.

In conclusion, I hope that this summary sketch of the work upon which the Marine Biological Association is employed on behalf of His Majesty's Government may convey, however imperfectly, an idea of what is going on under the international scheme for the investigation of the North Sea.

If time permitted it would be interesting to discuss the various directions in which knowledge of the kind which is being acquired bears profoundly on other proposals for the improvement of the fisheries.

Our work, however, is but a fraction of the whole of this great enterprise. It is to the future we must look for definitive results. Nevertheless, the few examples which I have brought forward serve to illustrate both the intricacy and the regularity of the order of Nature. Decrease the number of plaice and the growth of the remainder goes up. Increase the numbers of haddock and the growth of the plaice goes down.

The recognition of this principle and its working out in detail are clearly essential to a correct appreciation of the complicated factors which conduce to the maintenance of the supply of fish.

DISCUSSION.

Mr. C. Minchin said he wished to ask a question on a point which rather puzzled him. The author said the plaice when put on a favourable feeding ground increased much more rapidly in size than when on an in-shore and unfavourable ground, and there was a general impression that the plaice came to the age of sexual maturity at a certain approximate limit of size. Was it ascertained that the plaice arrived at sexual maturity at that limit of size independently of its age? Was a plaice which, on a favourable ground, arrived at a size of 14 inches in four years, sexually immature compared with the same plaice which lived on an unfavourable ground, and would not arrive at the same size and at sexual maturity until the lapse of six years of growth?

Mr. W. H. Pibel asked the author to explain how, supposing the experiment he suggested were carried out, he proposed to prevent the fishes from being caught directly they were transplanted, and how he proposed to reserve the fishes for the benefit of the fishermen of Hull and Grimsby, who would be at the expense of making the experiment?

Mr. J. N. Shoolbred, in dealing with the question of migrations of fishes, especially the herring, said the impression which prevailed was that the herring in the Channel passed to the west of the Scilly Isles, then to the west in the shallower portion of the

Atlantic, and gradually found their way in the Gulf-stream current up the outside of Ireland, round the Hebrides to the Shetlands, and later in the season came down again round the English coast, and so finished the circle. Though that matter was not within the limits of the paper, it would be useful if the author could give some information on the subject.

Mr. HUBERT BASS suggested for the consideration of the Marine Biological Association and other scientific bodies working for His Majesty's Government that there was a possibility of carrying the food to the fishes rather than carrying the fishes to the food. It was the usual custom in fattening creatures up for market to take their food to them. It was possible that system might have been tried with regard to fishes and found quite impracticable, but was it not possible to flavour, say, a residual substance with an essence of mollusk, and sprinkle it along the coast where the fishes lived? That could probably be done at a much less expense than conveying them to the Dogger Bank, hundreds of miles away.

Mr. GARSTANG, in reply, said that the question of the relation of maturity to size was one upon which it was possible to speak fairly definitely. Earlier in the investigation size was the only available index of maturity, but varied in different areas. They had now ascertained that the plaice in general matured at a given age, not at a given size. In the North Sea the female plaice had to be five years old before she matured, irrespective of size. The plaice might be five years old on the in-shore grounds and only 12 inches in length, whereas on the Dogger Bank she would be as much as 15 or 16 inches in length at that age. If some of the transplanted fish which were put on to the Dogger Bank at two years of age grew up to maturity, it would be readily understood that they would have the benefit of growth for a much longer period than any other fish in the North Sea, which would level up the size of maturity to an unprecedented extent—something like 20 inches in length. It was quite certain that it was age and not size which determined the maturity. There was reason to believe, however, that in the western part of the English Channel the plaice bred a year earlier than in the North Sea, and their rate of growth was much more rapid; but they seemed to belong to a different race of plaice. The question asked by Mr. Pibel as to how fishermen were to be prevented from catching the transplanted fish too soon was a very pertinent one. The point had been carefully analysed and discussed in the printed report of the Association, where it was pointed out that the steam trawlers did not go to the Dogger Bank in the summer months with anything like the same frequency as in the earlier part of the year. In March, April, and perhaps the early part of May the steam trawlers fished very extensively, — doing what was generally called the Easter fishing, and it was during those months that the greatest number of the marked plaice had been re-captured. On the other hand, during June, July, August, and September, very few re-captured fish had been caught by fisherman of any nationality, but in October and November there was again a great increase in the number of fish caught, which coincided with the well-known tendencies of steam trawlers to fish along the south-eastern edge of the Bank. He could entirely confirm what was said in the report with regard to the difference of intensity of fishing in different seasons. If the transplanted fish were not put on the Dogger Bank until the end of May, they were pretty certain not to have any considerable proportion of them prematurely destroyed. If, on the other hand, they were transplanted in the month of April, a large number of the little fish would be prematurely destroyed. If the former course was adopted, the fish would have a considerable time, until the following autumn, in which to attain an increase. The next question asked was that, supposing the Hull and Grimsby boats subscribed, say, £1 a piece to defray the cost of the experiment proposed, how were the transplanted fishes to be reserved for the capture of those particular men? The fishing itself determined that question. The number of English steam trawlers, compared with the number of foreign trawlers, was at least 10 to 1, and more than 90 per cent. of the fish transplanted in the North Sea would be sure to be caught by English steam trawlers. There was, therefore, no need under these circumstances to attempt to make an artificial ring round those fish for the special use of English fishermen. He was not an expert on the question of the migration of the herring, but it was known that the herring in the English Channel were exactly like the herring in the North Sea, *i.e.*, there was no structural difference between the herring in the Channel and the herring which came down the east coast of Scotland and England. It was possible, therefore, that they might go out to the Atlantic through the Channel, but that was not definitely known. He should very much like experiments to be made by marking a number of the herring in order to demonstrate the fact, but the catching of herrings alive in sufficient number to work was a delicate operation; and no success of any value had yet been obtained with any regard to that species. Then, it had been suggested that instead of taking the plaice to the food, the food might be brought to the plaice, by making essence of mollusk, and dropping tabloids of the essence in the water. He did not know whether the question had been put to him seriously, but attempts had been made to make artificial bait, and it was also true that French fishermen attracted shoals of sardines and other fish by putting odoriferous things in the water. The plaice, however, was not a creature that fed by smell, but a creature that fed by sight; and it would therefore be necessary to first of all make a tabloid, imitating the little mollusks in shape, appearance, movement,

and other things, before getting the ordinary plaice, unless it became very highly cultivated, to tackle it.

Mr. G. L. ALWARD said that he had watched the investigation in connection with the North Sea Fisheries for a number of years, and was very anxious that the Government of the country should turn their attention to the subject. Although only a few years had elapsed since operations were commenced, a fund of information had come to hand which, from a scientific standpoint, must be of very great value. Many were sceptical as to whether any commercial value would be realised in the way the author suggested, but from a scientific point of view it was a fact that fish transplanted from grounds which were overcrowded produced wonderful results. He had been very much concerned with regard to the diminution of the fish in the North Sea, a subject he had been working at for many years. The Dogger Bank appeared to be the home of the flat fish. Fifty years ago the North Sea was very little known as a trawling ground, but the Dogger Bank was attacked thirty years ago and found to be swarming with a splendid kind of fish, which were somewhat thin, due to overcrowding. In the process of years, the thin fish were fished out and an altogether new race of fish of a firmer and more fleshy kind took their place, the new fish being about double the weight of the earlier fish. Haddocks at one time were also found in abundance in portions of the North Sea in a very thin condition, but as they were thinned out, they became firmer in condition. The whole of the North Sea had now been well fished, the enemies of the small fish had been annihilated, and those left had become primer, larger, and finer. On the Dogger Bank the number of fish, including plaice, had lessened, but the most peculiar thing was that the dab, a creature living on the same kind of food, had increased in enormous numbers. A scientific investigation therefore would produce an amount of much useful information. Another peculiar thing was that where small fish abounded large ones were seldom found. The currents to which the author referred played a very important part in connection with the distribution of fish. The currents in the centre of the North Sea persistently went to the eastward, and the eggs of the fishes were carried in enormous quantities on to the shores of Holland, Denmark, and Germany. He thought it was a question for the Government to take into consideration, whether the North Sea was not being over-fished, and whether something could not be done to prevent the annihilation of English fishing grounds.

On the motion of the CHAIRMAN, a vote of thanks to Mr. Garstang was carried, and the meeting terminated.

THE AGRICULTURAL WEALTH OF BRITISH INDIA.

In no part of the Empire are there such dense masses o the population dependent upon agricultural pursuits as in British India, and in consequence there is no part of the Empire in which agricultural matters are recorded with greater statistical detail. What has taken place during the last quinquennium is recorded in a couple of volumes* compiled under the supervision of the Director-General of Commercial Intelligence. From these, the following particulars have been collected.

Area.—Taking British India, as a whole, the total area, which has been covered by professional survey, amounts to 554,234,736 acres, of which 67,136,162 acres consists of forest land, while 138,373,825 acres are returned as unfit for cultivation, and 103,395,256 acres are classed as culturable waste. The total area sown with crops, amounts to 208,901,314 acres, of which 187,506,886 acres are under food grains. Upwards of 70,224,000 acres are devoted to rice, 23,612,000 to wheat, and the balance to native grains—such as jawar, bajra, ragi, gram, &c.

Sugar cultivation is carried on over an area of 2,417,000 acres, coffee over 104,239 acres, and tea over 506,287 acres. In regard to the last-named, there has been an increase of 23,300 acres in the last five years. Some 3,234,000 acres are devoted to linseed, 4,652,000 acres to sesamum, 3,429,000 acres to rape and mustard, and 3,320 acres to other oi seeds, making a total under oil seeds of 14,545,000 acres.

The area under cotton reached its largest extent in 1903-04, and shows a distinct increase during the past twenty years, the total cotton bearing area being under 12,000,000 acres. The cultivation of jute, which declined from 2,275,000 acres in 1894-95, to 1,691,000 acres in 1898-99, has increased to 2,504,000 acres in 1903-04. Other fibres are cultivated over an area of 669,000 acres. As regards indigo, the area under cultivation in 1904-05 was 473,757 acres, a marked decrease on the area of 712,757 acres cultivated in the preceding year, and a sad decline (for which the synthetic preparation of indigo in Germany is responsible) from the maximum area of 1,705,977 acres cultivated in 1894-95.

The cultivation of opium is more stable, the area of 667,711 acres reported for 1903-04 making a record, the average for the preceding five years being under 620,000 acres. The area devoted to tobacco was 975,652 acres.

Live Stock, Ploughs and Carts.—The total number of bulls and bullocks is returned at 29,571,963; cows numbered 21,538,044, bull buffaloes amounted to 3,343,938, and cow buffaloes amounted to

* "Agricultural Statistics of India, for the years 1899-1900 to 1903-04," in two volumes. Volume (1) British India, and (2) Native States. Issued at the office of the Superindendent of Government Printing, Calcutta. Price of both volumes, 3 rupees 8 annas.

9,202,791. Young stock (*i.e.*, calves and buffalo calves) amounted to 25,081,834, sheep to 17,904,748, goats to 24,910,833, horses and ponies to 1,270,579, mules to 54,479, donkeys to 1,175,334, and camels to 381,726. With the exception of horses and ponies, and of camels, which declined in number, increases took place under each head. The number of ploughs, which had declined continuously during the four preceding years, increased to 13,985,548, and carts increased to 3,203,482.

Land Revenue.—The total land revenue, excluding cesses, amounted to 6,05,10,225 rupees, giving an average incidence per head of population per annum of 1 rupee 9 annas 4 pies. Reckoned per acre of fully assessed total area, the average incidence works out at 1 rupee 3 annas and 11 pies.

Production of Specific Crops.—The total production of tea during 1904 is returned as 222,203,661 lbs., or over thrice the total production in 1885. The quantity of manufactured tea is given as 5,824,557 of green tea, and 207,305,224 lbs. of black tea. With regard to coffee, there is, as has frequently occurred, a wide margin between the reported production, which is 28,746,210 lbs., and the quantity exported, which was 36,920,464 lbs. The yield of rice in 1904-05 amounted to 436,114,800 cwts., and the yield of wheat is 7,533,841 tons. The reported estimate of cotton produced was 3,507,068 bales. The yield of sugar-cane during 1904-05 was 2,166,156 tons. In 1904-05, the yield of indigo was only 56,200 cwt., or almost one-fourth of the production about nine years before. In regards to jute only provisional figures are at present available for 1904-5, these giving the yield as 7,400,000 bales, almost, but not quite, a record aggregate production.

The Value of Irrigation.—Much might be collected from pages 351 to 380 (inclusive) on the value of irrigation. A few instances alone will suffice, the latest returns being the average for the five years ending 1901-02. The yield of rice in the Panjab was 1,126 lbs. per acre from irrigated land, and 734 lbs. from unirrigated. The yield of cotton in the United Provinces was 190 lbs. of cleaned cotton per acre of irrigated land as against 130 lbs. for unirrigated land. Or again, in the North-Western Frontier Province, the respective figures for cleaned cotton are 183 and 72. Or in Madras, for bajra, the respective yields are 766 and 545, and for wheat in the Central Provinces, 925 and 570. No more eloquent apology for the extension of irrigation could be, or need be, advanced, than a quotation of such figures as those just cited.

THE CATTLE INDUSTRY OF THE RIVER PLATE.

The River Plate country, which includes the Republic of Uruguay and a great portion of the Republic of Argentina, has long been included among the leading stock-breeding districts of the world. For generations, the inhabitants have looked upon the ranch as about the only source of material wealth. They were in past years, and to a very large extent, still are, a meat-eating people, and have given but little attention either to general agriculture or to truck farming. The cattle of the country needed no special care, as grass of the best quality for maturing and fattening grew in great abundance over this entire country, and remained fresh and green during the whole year. The climate is such that domestic animals needed neither grain nor shelter. Until recently, the cattle roamed the plains at will, in a semi-wild state, and they were allowed to breed and in-breed without any care or attention from the owner. At that time, the sale of the hides was the only part of the industry that yielded the owner any money. and the meat, except a small portion required for food, was discarded as of no value. The American Consul at Montivideo says that of recent years, however, the meat-eating people of other parts of the globe have been attracted to the River Plate, and have not only provided a wider market for its products, but have given its chief industry their attention. A large market has been provided for cattle by the manufacture of beef extract, which is carried on very extensively. The ever-increasing demand for leather has opened up the market, and increased the price of hides, and the bones and horns find a ready sale, with the result that the cattle-breeding industry has become very profitable. As prices increased, and the business yielded greater profits, the ranch owners gave more attention to the business. They have fenced their farms, and have devoted attention to the improvement of breeds. Within the last few years freezing plants have been established, both in Montevideo and Buenos Ayres, where meat is prepared for export. These establishments, although new, are already exporting annually enormous quantities of their product. As a result of the markets, a revival has taken place in the stock-breeding industry, and this is most noticeable in regard to cattle. The best class of animals, with good pedigrees, are sought after, and are taken only from countries free from cattle diseases, and which are subject to proper sanitary regulations. The stimulus given to cattle breeding arising from the conditions mentioned, and the scarcity of good bulls in Argentina and Uruguay, will make the River Plate market an attractive one for many years to come, as the breeders will be compelled to go abroad to secure at least a portion of the necessary high class breeding stock, and the great bulk of the business will come to the United Kingdom.

STATE AID TO JAPANESE INDUSTRIES.

Every industry in Japan needing help, is specially aided and assisted by the Government, and State assistance in this direction is not a new idea in that country. Under the feudal system of old Japan it

was exercised in the broadest possible sense. The Government is exercising at the present time a supervision over all the industries it does not control, and fostering in every way the development of new ones, and this is what is making Japan commercially strong, and a dangerous competitor in the trade of the Far East. As is well known, the Japanese Government now controls many of the important monopolies. A large percentage of the railways, the telegraph and telephone lines, the salt works, the tobacco monopoly, and the camphor production are directly under the control of the Government. The following is a list of the factories conducted by the Government:—The printing bureau (which includes printing, type foundry, and paper mills), mint; Tokyo arsenal; Osaka arsenal; Senjü woollen factory, canning factory, surveying and map drawing; Yokusha shipyard, dockyard, and arsenal; Kure shipyard, shipbuilding, ship engine, and arsenal; Shimose powder works; Takeshiki dockyard; Ominto dockyard, steel works, telegraph and lighthouse stores, and railway works. For many years it has been recognised that the Government was the power behind the silk industry, and the great development of this industry during the last few years has been largely due to Government assistance. In fact throughout the empire, in every branch of trade and industry, the Government will be found close at hand to render assistance, either expert or financial, through one of its many channels. The American Consul at Yokohama, cites as an excellent illustration of the care with which the Government guards the interests of the people in industrial matters, the case of the use of fertilisers, by the Department of Agriculture. This branch of the public service undertakes the scientlfic examination of the value of the different fertilisers imported, and advises the farmers as to their relative value and utility. The importation of fertilisers is one of the most important items in Japanese commerce. Throughout the Empire there are banks, whose business it is to advance money on growing crops, or to help financially in the development of some industry. More important, however, than these institutions is the Industrial Bank of Japan. This bank was established in 1902, and besides doing a general banking business, it makes loans, takes up public loan bonds, local loan bonds, company debentures, &c. In line with her activity on land is Japan's determined effort to increase the efficiency of her merchant marine. Only a short time ago, the Japanese newspapers heralded the fact that one of the subsidised lines had made an effort to purchase the entire equipment of one of the American Pacific steamship lines, and there appears to be no doubt that the Government also is interested in this. The influence of the Government is felt in all branches of commerce and industry. Such paternalism exists, that no one in business, pressed by the exigencies of the times, hesitates to call upon banks, indirectly controlled by the Government, for assistance. In fact, the commerce of Japan is to-day almost entirely supervised by the Government.

Against this Government ownership of industries, and paternalism, there is, however, some opposition which appears to be growing. This is evidenced by the meeting held in Tokyo in October last, at which all the Chambers of Commerce of Japan were represented. Among other important resolutions passed, was one which set forth that Government monopolies —such as tobacco, salt, camphor, &c.—are desirable, neither as a Government resource, nor as improving the industry. The salt monopoly, first of all, should be abolished as soon as some other resource is found, and there should be no other Government monopoly. What effect, if any, these resolutions will have upon the Government is not known. Japan is attracting the attention of the world to her porcelain products. The industry is one of the oldest in the Empire, having come from China centuries ago, but it has only been in recent years that Japan has exported her porcelain ware to any extent. At the present time the combination of Oriental with Occidental ideas has developed an article which finds a ready sale in the markets of the world. Many fine imitations of French work are made and are largely sought after. Among other considerations, the introduction of foregn machinery in at least two of the large porcelain factories has been responsible for the growth of this industry. Most of the factories, however, employ the crudest means in the manufacture of porcelain, even moulding by hand, and the percentage of damaged goods due to imperfect moulding is very considerable. Few industries in Japan have shown a more substantial growth than the manufacture of cotton yarn and fabrics. Throughout the Empire cotton mills are beng erected, and late reports indicate material growth in cotton manufactures generally. At the present time Japan is able not only to aupply her own wants in a large measure, but is reaching out for the control of the cotton yarn and fabric market of China, which has long been one of the best customers for European and American cotton goods. Japan is at present dependent upon the United States and India for her raw cotton. She has nelther the domain nor the climate necessary to produce cotton in large quantities, but her influence will be keenly felt in the sale of cotton yarn and fabrics. As a Japanese writer recently said:—"She is better qualified to supply the Oriental demand for cotton goods than any other country. She knows and understands the wants of her people, and those generally of the Far East, and is preparing to supply them. This, added to her geographical position, will make her a dominant factor in the cotton trade of the Far East." In manufacturing development, Japan is making progress in the production of iron, steel, electric light appliances, wire, rails and cars, and in a great variety of articles. Linen is brought from Ireland and made into collars, cuffs, drawn and embroidered work, and then sent to Europe and the United States.

HOME INDUSTRIES.

The Cocoa Industry.—In the course of his speech at the statutory meeting of the shareholders of the Liberian Rubber Corporation, Limited, Sir Harry Johnston incidentally mentioned that "there is a small area in Ecuador, South America, which produces the very finest quality (of cocoa) and the second best quality—practically the first quality so far as the world at large is concerned—comes from a Portuguese island in the Gulf of Guinea." Ecuador not only produces the finest quality of cocoa, its cocoa crop is larger than that of any other part of the world, and is rapidly increasing. But the most noticeable increase, taking the latest figures, those of 1904, is on the Gold Coast. The increase in 1904, as compared with 1903, was no less than 148 per cent. The district of Accra alone produced 515 tons, and Lagos and Nigeria together 53 tons, most of which was shipped to Hamburg and consumed in Germany. Then comes San Domingo, where the plantations are in the hands of small farmers, with the exception of a few large estates the most important of which belongs to the Swiss chocolate firm Suchard. A recent issue of the Hamburg *Gordian* gives some interesting tables showing the cocoa crops of all countries in the four years 1901-4. A few of the principal may be noted:—

	1903. Tons.	1904. Tons.	Inc. or Dec. Per Cent.
Ecuador	23,238	28,433	+ 22¼
Brazil	20,738	23,160	+ 11½
St. Thomas	21,450	20,526	— 4¼
Trinidad	14,885	18,574	+ 25
San Domingo	7,825	13,557	+ 74
Grenada	6,150	6,226	+ 1¼
Gold Coast	2,297	5,687	+ 148

It is a little surprising that Grenada, which owes its great prosperity entirely to cocoa, and whose product is always in demand in the London market even when other sorts are unsaleable, does not extend its cultivation more rapidly. In lack of enterprise, and capital may be found the explanations. Young Englishmen with a little capital, and plenty of "grit," should do well as cocoa planters in Grenada and other West India islands.

Producers and Manufacturers.—It is noticeable that year by year manufacturers of cocoa are getting into more direct communication with producers. Much of the cocoa that passes through Hamburg, Havre, and New York goes straight to the manufacturer without being handled by the middleman. It is only in London and Amsterdam that cocoa is largely sold at public auctions, Amsterdam holding some eight auctions of Java cocoa annually. Until recently the whole of the Trinidad and Ceylon export came to London, but now much of it goes to the Continent direct, the sale being quicker there than here. German and other steamers take the Trinidad product to Hamburg, Havre, and New York. The largest consumer of cocoa is the United States, which in 1904 took 33,159 tons. The figures for 1903-4 of the six largest consuming States are as below:—

	1903. Tons.	1904. Tons.	Inc. or Dec. Per Cent.
United States	28,508	33,159	+ 16¼
Germany	21,491	27,101	+ 26
France	20,638	21,799	+ 5½
United Kingdom	17,485	20,552	+ 17½
Holland	16,741	21,124	+ 26
Switzerland	5,556	6,539	÷ 17

Among other countries we find Austro-Hungary increasing her consumption by 24½ per. cent. and Russia by 8¼. Canada only took 650 tons and Australia 550 tons in 1904, but the increase, as compared with 1903 was 11 and 24 per cent. respectively.

Railway Receipts.—The effect of tube, tramway, and other competition upon the receipts of railway companies largely dependent upon passenger traffic is shown in the accounts of the North London Railway for the year ended December last. The dividend on the ordinary stock for the second half of 1905 is only 4½ per cent., as against 5 per cent. for the corresponding period of 1904, the dividend for the whole year 1905 being 4¾ per cent., as against 5½ per cent. for 1904. Five years ago the company had first to reckon with electric tubes, then came electric tramways, and now there are the motor-omnibuses. The result of this extra competition has been that in the five years the company's revenue from passenger traffic has been reduced by about £23,000 per annum. Nor is this the extent of the loss, for in order to check the desertion of their passengers the company has been obliged to lower fares, which means a further loss of £20,000 a year. Add to these amounts an increase of £9,600 a year in rates and taxes, and there is an annual loss of £52,600, which is equal to a dividend of over 2½ per cent. And perhaps the most serious feature as it affects railway companies is that the loss of passenger traffic goes on increasing. For example, on the North London 614,639 fewer passengers were carried in the six months ended December, 1905, than in the corresponding six months of 1904. In Liverpool, Manchester, Birmingham, indeed all the great towns in England, the railway companies serving them have to reckon with similar losses, more or less, but all serious and growing, of passenger traffic. What is the remedy, or is there any? Lord Bathmore refers to two which have been pressed upon the North London Company—reduction of fares and electrification. But obviously there is a point beyond which the first course cannot be taken. A reduction of a farthing a mile on the North London means a loss of £45,000. Then as to electrification, the difficulties in the way are very great, the greatest of all being that of capital expenditure. The outlook is not very

cheering, and, so far as the passenger traffic of the great towns is concerned, it is difficult to see how the railway companies can make headway against tubes, cars, and 'buses, but in the country the motor omnibus should be a valuable feeder for the railway company.

The Brewing Industry.—The brewery reports now being issued for the past year show that they too, like the railway companies, have had to reckon with difficulties which in many cases, if not in most, have adversely affected dividends. Whatever the cause, the consumption of malt liquor and of spirits continues to decline. The chairman of one brewery company is able to tell the stockholders that their customers have increased but then the average consumption has fallen. Other companies do not complain so much of falling off in customers as decrease of average consumption, from which it would seem that the diminution in the total consumption is due rather to lack of means than of change in the desire to consume, a view supported by the fact that the falling off in consumption is much more noticeable in the East-end of London than in the West. The number of the unemployed, and of those working short time, has been unusually large during the past six months. Then the additional burden thrown upon the brewing industry by the Licensing Bill of last year is considerable, and cannot be shifted altogether upon the licensed victualler. Add the losses of many breweries in reckless tied-house dealings, and the growth in local taxation—the publican's rates have increased 90 per cent. during the last twelve years—and there is nothing strange in the present depression. It is to be noted that in the present House of Commons there are only twelve members connected with the brewing trade, as against more than 100 barristers.

The Thames Shipyards.—It was announced on Saturday that Messrs. Yarrow have purchased some twelve acres of land with a river frontage of 780 feet at Scotstoun, within a few miles of Glasgow, to which they intend to remove their works as soon as the necessary arrangements can be made. In removing to the Clyde Messrs. Yarrow will continue to devote themselves to the building of torpedo-boat destroyers, torpedo-boats, Yarrow water-tube boilers, and vessels of exceptionally shallow draught, while they will also develop the building of small vessels propelled by internal combustion engines, a branch of the industry which they are now trying to develop. As was recently pointed out in these Notes, many causes have combined to bring about the migration of the great shipyards on the Thames. The high price of land, the high rate of wages, the distance from the sources of raw material, all have operated against the Thames; and in the case of Messrs. Yarrow the growing burden of local taxation has probably been the final and determining cause of the migration. In Poplar the rates have gone up to over 10s. in the £, and unless an Equalisation of Rates Bill is approved by Parliament quickly, this rate, unprecedentedly high as it is, is likely to be increased. As the principal employers of the district, Messrs. Yarrow have been the chief sufferers, and they go where the burden is less. Only two great firms will now remain upon the Thames, Messrs. Penn, now combined with the Thames Ironworks, and Messrs. Humphries and Tennant. Perhaps the change was unavoidable, but Londoners cannot be expected to view it without regret.

The Leather Trade.—Both in volume and in value the figures for the leather trade of the past year are satisfactory. We exported 206,845 cwt. tanned and unwrought leather of the value of £2,112,823, a record export, as the following figures show :—

	Leather—Tanned, Unwrought.	Boots and Shoes.
	£	£
1890	1,388,306	1,898,290
1900	1,439,531	1,479,148
1904	1,714,090	1,581,842
1905	2,112,823	1,882,294

There were increases, too, in "saddlery and harness" and "gloves," of £41,069 and £37,533 respectively, as compared with 1904. Of the increase in the exports of boots and shoes no less than £230,000 is accounted for by the increase in the value of the exports to the South African colonies and New Zealand. Notwithstanding the large increase in the export trade the imports of leather were less in 1905 than in 1904, being 1,137,854 cwts. as compared with 1,151,405 cwts. in 1904. But though the imports decreased 13,551 cwts. the value was greater by £29,104, being £8,086,011 as against £8,056,907 in 1004. High as is the present price of leather the indications point to higher prices. The staple industries of the country are improving and the leather trade is identified with them all. The export demand is likely to continue to increase, and it is not easy to see where increased imports are to be got from in the near future. The home demand in America makes it certain that it will not come from that quarter, and the same may be said of the Colonies.

The Motor Omnibus and Capitalists. — The peculiar risks that have to be faced by capitalists concerned with the motor-omnibus industry may be gathered from facts mentioned by the chairman of one of the horse omnibus companies that has to provide a motor-omnibus service to save itself from extinction. The life of a motor omnibus is still uncertain but this company is making provision for depreciation at the rate of 25 per cent. per annum, and the machinery of these vehicles changes and improves so quickly that it may well be doubted whether even this is a sufficient margin for the risk. The horse omnibus companies have had to face difficulties of a very exceptional character. They have survived the competition

of the tube and the tram and are not perhaps much the worse for it. But the motor omnibus threatens much more formidable rivalry. The horse companies cannot hope to hold their own if they continue to rely entirely or mainly upon the horse; they shrink from a large capital ontlay upon motor omnibuses that may be out of date two years hence, and yet they cannot afford to wait until invention has finally settled the best pattern of vehicle lest in the meantime the motor omnibus companies secure a command of the traffic that will put them (the present horse companies) at fatal disadvantage.

NOTES ON BOOKS.

TELEGRAPHY. By Sir W. H. Preece, K.C.B., and Sir J. Sivewright, K.C.M.G. (Text-books of Science.) Eighteenth impression. London: Longmans, 1905.

The first edition of this well-known book was published in 1876, and a comparison between the two issues forms a very remarkable and striking illustration of the growth of the science in the past thirty years. The volume of 300 pages has expanded to one of 500, but it is in the matter rather than in the amount of material that change is noticeable. In 1876, ocean telegraphy could, at all events, be omitted from a text-book such as this. Quadruplex and multiplex telegraphy were interesting novelties, but had not borne the test of experience, and so were not entitled to consideration in a work confined to practical and tried methods. The telephone was yet to be invented, and wireless telegraphy was still in a then distant future. Accumulators were unknown, and the battery was the only generator in use. How great the changes have been in telegraphic methods and appliances, only experts fully know, but those who desire to familiarise themselves to some extent with the details of an advance of which we are all conscious, will find full information in the pages of the latest edition of "Preece and Sivewright."

A SYSTEMATIC COURSE OF PRACTICAL ORGANIC CHEMISTRY. By L. G. Radcliffe and F. S. Sinnatt. Longmans, Green, and Co.

This book is apparently a collection of papers of exercises for the authors' own students, and in places bears marks of somewhat hasty collation. The authors give a well graduated series of experiments and preparations, beginning with methods of detection of the elements which are most likely to be present in organic substances, simple physical determinations, and molecular weights, and then proceed to experiments on the preparation and properties of organic compounds. Most of these are well chosen and the directions are practical. The book, it should be noted, presupposes that students are working from it under the supervision of a teacher who, using it as a guide will fit up modern apparatus to his taste, and *e.g.* (p. 16) guess what the mixture is which leaves a "yellowish residue" when boiled with water, this residue being soluble in hot alcohol. These omissions, which it is fair to state are hinted at in the preface, in some cases might be remedied in a further edition, and in others have the advantage of causing the student in think. In the special part for advanced students methods of qualitative organic analysis are given, and also the student is instructed how to determine carbon, hydrogen, nitrogen, halogens (by Carius's method, not by combustion with lime) and sulphur, and to determine molecular weights by Raoult's methods. The book is printed on one side of the paper only, so that the student or teacher may make notes and sketches in his copy.

THE PRINCIPLES OF CHEMISTRY. By Dr. Mendeléeff. Third English edition. Translated from the Russian (seventh edition) by George Kamensky and edited by Thomas H. Pope. Two volumes. Longmans, Green and Co., 1905.

"In carefully preparing this edition I have not lost sight of the fact that I am hardly likely to publish another, and I have therefore in many cases spoken more definitely than formerly. After having been an insignificant but zealous worker in chemistry for almost half a century, I wished that my book should retain some traces of how a confirmed disciple of Gerhardt regards the fundamental problems of the theory of the chemical elements at the beginning of the twentieth century. As an example I may mention that the more I have thought on the nature of the chemical elements, the more decidedly have I turned away from the classical notion of a primary matter, and from the hope of attaining the desired end by a study of electrical and optical phenomena, and the more clearly have I recognised that first and foremost are needed truer conceptions of 'mass' and 'ether' than those in vogue at the present time. The return to electro-chemism, which is so evident in the supporters of the hypothesis of 'electrolytic dissociation,' and the notion of a splitting up of atoms into 'electrons,' in my opinion only complicate and in no way explain so real a matter (since the days of Lavoisier) as the chemical changes of substances, which led to the recognition of the invariable and ponderable atoms of simple bodies."

This "confession of faith," touching in its reference to the age and long labours of the author, is interesting as indicating a strong adherence to the atomic theory on the part of so distinguished a chemist. Even after making due allowance for the conservatism of the aged, it must be considered as an important warning against too sudden changes in our conception of matter. To the author, the atom is still the real thing which it was before electrons became fashionable.

The book, whether we consider its author as the

picturesque champion of an outworn creed, a Quixote tilting at windmills, or as a real apostle of orthodoxy, is a weighty one. Written, avowedly for the young student, it is useful as a work of reference for all engaged in the practice or teaching of chemistry, in fact, one is inclined to wonder whether the young Russian student is not a much more advanced product than his English brother. Although not differing very much from the previous English edition, the work appears not only to have been brought up to date in many respects, *e.g.*, the gases of air are more fully described, in view of the researches of Lord Rayleigh, and Sir William Ramsay, and their pupils, but to have been re-translated very carefully. Unlike many scientific works, it is essentially a *book*. It is not merely that one is continually reminded of the dominant individuality of the author, but it possesses a readability and literary tone too frequently absent from such works. It covers the whole range of theoretical and descriptive inorganic chemistry. The arrangement is orderly without being aggressively systematic, various chemical and physical conceptions and "laws"* are introduced and explained as occasion demands. The periodic law, of which the author was the first definite enunciator, although our own countryman, John Newland (whose "law of octaves" was received with derision) and Lothar Meyer in Germany had at least prepared the way, receives very full treatment, and is insisted on as exhibiting in a very real manner the relationship of those substances which we at present know as elements. The ingenious conception of a zero group provides places for helium, argon, neon, krypton, &c., and there are apparently several elements awaiting discovery. The wonderful fulfilments of Mendeléeff's prediction in the cases of scandium, gallium, and germanium ensure for the law a considerable amount of respect as an attempt to indicate the simple, harmonious relationships which undoubtedly exist between the elements, a relationship which is frequently lost sight of.

An essay on a chemical conception of the ether forms one of the appendixes of the book. In this the author, true to his materialistic views, suggests for the ether a material existence as a very subtle gas pervading the whole of the universe and having a place in the periodic arrangement of the elements—a place suggested by means of extrapolation in the said group. The conception is certainly ingenious, and is likely to appeal to the ultra-chemical school of chemists. Both volumes are well illustrated, although in some cases apparatus of historical rather than actual value is figured as being used in ordinary experiments. A portrait of Lavoisier forms the frontispiece of the first volume.

* For want of a better this word, which is applied alike to the Decalogue, the Aliens Act, the rules of racing, or football, and to all sorts of physical and chemical relationships is used here.

GENERAL NOTES.

English Lady Student Teachers in France.—The next Examination for English student teachers in French Training Colleges will be held in London during Easter week. The students who enter for these posts, pay £16 into the college funds and devote a certain amount of time, not exceeding ten hours a week, to conversing in English with the French student. In return, they receive board and lodging, and the permission to attend all the classes in French history, literature, &c., held at the College. Forms of application may be obtained from the Director of Special Inquiries and Reports, Board of Education Library, St. Stephen's-house, Cannon-row, London, S.W.

Italians in Australia.—In his report upon the trade of South Italy for 1905 (No. 3530, Annual Series) Mr. Consul-General Neville-Rolfe mentions a rather curious fact. Just as in England, certainly in London, most of the restaurants are under Italian management, so in Australasia the fruit trade is almost entirely in their hands. The emigration of Italians to Australasia was due largely to the ravages of the phylloxera, which deprived them of their means of livelihood at home and drove them to carry on their business of gardening in Australasia, where they are known as Sicilians, although most of them hail from the Lipari Islands and the mainland. In 1880 there were two fruit shops in Sydney, one in Princes-street and the other in George-street, both kept by Italians. Now there are 155 in Sydney and the suburbs, and about 260 in Australia altogether. These men—Italians—have generally done well, and many of them have returned to Italy, paid off mortgages, built houses, and settled again in their own country. A few Italians have started the same business in New Zealand, and have also been engaged in the fishing industry there, but there enterprise is not encouraged, and difficulties are made as to their return to the colony in case of their going home to visit their friends.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

February 28.—"London Traffic." By Captain G. S. C. Swinton (L.C.C.). Sir John Wolfe-Barry, K.C.B., LL.D., F.R.S., will preside.

March 7.—"Art in Painting and Photography." By J. C. Dollman, A.R.W.S. David Murray, R.A., will preside.

March 14.—"Imperial Organisation from a Business Point of View." By Geoffrey Drage. The Right Hon. Alfred Lyttelton, K.C., will preside.

MARCH 21.—"Motor Boats." By BERNARD B. REDWOOD, B.A. SIR JOHN I. THORNYCROFT, LL.D., F.R.S., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 15.—DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit., "The Languages of India and the Linguistic Survey."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 6.—"Imperial Questions in the West Indies." By SIR NEVILE LUBBOCK, K.C.M.G. The RIGHT HON. LORD STRATHCONA, G.C.M.G., will preside.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

MARCH 20.—"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A. WILLIAM A. LINDSAY, K.C., Windsor Herald, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

LECTURE I.—MARCH 12.—The Science of Fire—Ignition—Slow Combustion—Spontaneous Combustion—Results of Combustion—Flame—Smoke—The Oxides of Carbon, and Water Vapour—Causes of Fire and their classification.

LECTURE II.—MARCH 19—Fire Risks—Matches—Defective Flues and over-heated Stoves—Action of Heat on Wood—Pyrophoric Carbon—Lighting Dangers—Candles, Oil Lamps, Gas, and Electricity.

LECTURE III.—MARCH 26.—Storage Dangers—Spontaneous Ignition of Material in Bulk—Lampblack—Charcoal—Coal—Fibre—Greasy Waste and Rags—Vapours—Dust and Dust Explosions—Nitro Compounds—Collodion Goods.

LECTURE IV.—APRIL 3.—Fire Prevention—The Fallacies Existing as to Fireproof Material—Stone and Iron *versus* Wood—Heat Conductivity—Fireproofing Wood and Textile Fabrics—Fire Extinction—Sprinklers—Chemical Fire Extincteurs—Alarms.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Sir William White, "Modern Warships." (Lecture V.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Paper by the late Mr. John Leaning, "The Assimilation of the Practice of Quantity Surveyors."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, FEB. 27...Tramways and Light Railways Association (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Prof. C. A. Carus-Wilson, "Radial Trucks."

Royal Institution, Albermarle-street, W., 5 p.m. Prof. W. Stirling, "Food and Nutrition." (Lecture IV.)

Designers, in the Galleries of the Royal Society of British Artists, Suffolk-street, S.W., 8 p.m. Mr. F. Hamilton Jackson, "Romanesque Ornament and its Origins."

Medical and Chirurgical, 20, Hanover-square, W. 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m, Discussion on papers by:—1. Mr. G. R. Jebb "A Plea for Better Country Roads." 2. Mr. J. E Blackwall, "Country Roads for Modern Traffic."

Photographic, 66, Russell-square, W.C., 8 p.m. 1. Demonstration of his Pigment Paper by Mr. J. Page Croft. 2. Messrs. C. E. Mees and S. E. Sheppard, "The Estimation of the Colour-sensitiveness of Plates."

Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, FEB. 28...SOCIETY OF ARTS, John-street Adelphi, W.C., 8 p.m. Capt. G. S. C. Swinton "London Traffic."

Royal Society of Literature, 20, Hanover-square, W. 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Society for the Encouragement of Fine Arts, 6½ Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. C. E. Keyser, "Two Churches in Berkshire."

THURSDAY, MARCH 1...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. D. H. Scott, "A New Type of Stem from the Coal-measures." 2. Dr. H. C. Sorby, "Notes on some Species of Nereis in the District of the Thames Estuary."

Medical and Chirurgical, 20, Hanover-square, W., 5 p.m. Annual Meeting.

Chemical Burlington House, W., 8½ p.m. Mr. T. M. Lowry, "Studies of Dynamic Isomerism." Part IV. — "Stereoisomeric Halogen Derivatives of Camphor."

Royal Institution, Albermarle-street, W., 5 p.m. Mr. Francis Darwin, "The Physiology of Plants." (Lecture I.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. R. G. Allanson-Winn, "Coast Lines protected by Chain Cable Groynes."

FRIDAY, MARCH 2...Royal Institution, Albemarle-street, W., 9 p.m. Dr. R. Caton, "Hippocrates and the Newly Discovered Health Temple at Cos."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street. E.C., 8 p.m. Paper on "Pastel."

Geologists' Association, University College, W.C., 8 p.m.

Junior Institute of Engineers, Westminster Palace Hotel, S.W., 7 p.m. 1. Mr. A. P. Trotter, "Acceleration and Accleromotors." 2, Mr. L. F. de Peyrecave, "Gas Engine Indicators."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MARCH 3...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, 'The Corpuscular Theory of Matter." (Lecture I.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

TUESDAY, MARCH 6, 4.30 p.m. (Colonial Section.) SIR NEVILE LUBBOCK, K.C.M.G., "Imperial Questions in the West Indies."

WEDNESDAY, MARCH 7, 8 p.m. (Ordinary Meeting.) J. C. DOLLMAN, A.R.W.S., "Art in Painting and Photography."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

SIR WILLIAM WHITE, K.C.B., F.R.S., delivered the fifth and last lecture of his course on "Modern Warships," on Monday, 26th February. The CHAIRMAN (Professor W. E. Ayrton, F.R.S.) moved a vote of thanks to the lecturer for his valuable course of lectures, which was carried unanimously.

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, February 15; The RIGHT HON. J. E. ELLIS, M.P., Under-Secretary of State for India, in the chair.

The SECRETARY of the Section announced that an unexpected public engagement of an important character prevented the Secretary of State for India from fulfilling his promise to preside at the meeting. The Committee were greatly indebted to Mr. Ellis for kindly consenting to take Mr. Morley's place, at short notice.

The CHAIRMAN said he was very glad to take the place of his political chief. It was hardly necessary for him to say how very much Mr. Morley regretted his absence, which, as the Secretary had announced, was due to the claims of public duty. The paper of the afternoon was to be read by one of that large band of men sent out from this country to do good work in our great Indian dependency, Mr. Buckley, whose career and personality were probably well-known to the members.

The paper read was—

THE NAVIGABLE WATERWAYS OF INDIA.

By ROBERT BURTON BUCKLEY, C.S.I.

The great irrigation works of India water every year about twenty million acres of crops. The canals which carry the water aggregate some 12,000 miles in length and are supplemented by about 30,000 miles of distributary channels. The majority of these works have been constructed by the British Government, during the last sixty years, but some are old native works which have been restored and improved during the same period. The canals have, with one or two exceptions, been constructed primarily for irrigation: the chief object in view has been the improvement and security of the crops. The canals have been laid out to command the lands which required irrigation and were suitably placed for it, and they have not been laid out with a view to navigation. But, in a certain number of cases, the main canals have been so constructed that they can be used for navigation as well as irrigation. There are also three important canals in India which have been constructed solely for navigation and not for irrigation at all, and several minor ones of the same class. The map (p. 423) shows in black serrated lines the navigable canals in India, and the following statement gives the main statistics of them:—

TABLE I.—CANALS CONSTRUCTED PRIMARILY FOR IRRIGATION WHICH ARE ALSO NAVIGABLE.

Province.	Name of Canal.	Mileage of Irrigation Canals which are navigable.		Total mileage of Irrigation Canals.
			Total.	
Burma	Shivetachang Canal	24	24	204 (?)
Bengal ...	Orissa Canals.	205		
	Sone Canals.	218		
	Midnapore Canals.	72		
		——	495	719
United Provinces ..	Ganges Canals.	213		
	Lower Ganges Canal.	199		
	Agra Canal.	125		
		——	537	1,483
Punjab ..	Western Jumna Canals.	243		
	Sirhind Canal.	189		
		——	432	4,482
Madras ..	Godavery Canals.	493		
	Kistna Canal.	307		
	Kurnool-Cuddapah Canal	190		
		——	990	3,300
Sind	Fuleli Canal.	*120		
	Eastern Nara Canal.	180		
		——	300	1,670
		Total	2,778	11,858

Considerable lengths of the canals in Sind are natural channels which have been adapted for irrigation. Besides the Fuleli and Eastern Nara there are 850 miles of canals in Sind which are navigable in the flood season.

This statement shows that about one quarter of the aggregate length of irrigation canals in India has been made navigable. In some cases it was almost essential that the canals should have been so treated. For instance, in the case of the Kistna canals in Madras, the irrigation channels carry off all, or nearly all, the supply of water in the river at certain times, and cut off the upper reaches of the river from the sea. The navigable canals radiate from the head works at Bezwada towards the sea, and they traverse a flat and fully cultivated delta, which is badly provided with roads, and the people are accustomed to the use of boats. The Godavery delta is treated in the same way and for the same reasons. The Godavery and the Kistna systems of canals are connected by a navigable channel, and they are also joined with the Buckingham Canal, so in this part of the coast there is an extensive system of connected artificial canals which aggregate more than 1,000 miles in length.

* These are the lengths which are navigable all the year round.

The Fuleli and Eastern Nara in Sind are partly natural, and the latter may almost be considered to be a branch of the Indus. The Fuleli Canal, which enjoys an almost perennial supply, and is so situated that it was possible to make it navigable at a very moderate cost, is navigated by boats up to about 40 tons. From 800 to 1,000 of these transport about 20,000 tons of goods, chiefly grain, on it every year. A new railway was opened in 1904 close to the canal, and it has reduced the traffic on it to some extent, particularly that carried by the small steamers which used to run on the canal.

The following statement shows the principal canals in India which have been constructed for navigation only:—

NAVIGABLE CANALS NOT USED FOR IRRIGATION.

	Mileage.	
Lower Burma.		
Pegu.—Sittang Canal	39	
Sittang.—Kyaikto Canal..	13	
Twante Canal	7	
		— 59
Bengal.		
Circular and Eastern Canals.—A very large part of these canals are natural channels, which have been improved and maintained by Government. The artificial portion is perhaps 40 or 50 miles in length	737	
Orissa Coast canal (including the Tidal canal)	132	
		— 869
Madras.		
Buckingham Canal	262	
Vedarniyam Canal	35	
		— 297

There are also one or two other navigable canals in Madras.

The cost of these purely navigation canals has been about £1,500,000 sterling. They are not used in any way for irrigation and could not be so used, as the water in them is generally brackish. The canals are in immediate contact with the tidal creeks and rivers connected with the Bay of Bengal; indeed, the greater portion of the Circular and Eastern Canal, which connects Calcutta and Barrisaul in Eastern Bengal, consists of natural tidal channels which have been artificially improved, and which are maintained in a fairly efficient

state, in order to bear to Calcutta the products of the Eastern and Northern districts. The portion of the Orissa Coast Canal which is called the Tidal Canal was opened for traffic in 1869; it connects the Hugli river with the Russelpore river by two tidal ranges. The Orissa Coast Canal proper, which is a continuation of the Tidal Canal, was opened for traffic throughout in 1887; it consists of three ranges connecting the Russelpore river with the Matai river in Orissa. The united system is a line of navigable canal which opens inland water communication between Calcutta and Orissa. The Buckingham Canal in Madras, which has some features in common with the Orissa Coast Canal, is also a coast line. It was undertaken primarily as a protective work afrer the famine of 1877-78, in order to connect the Godavery and Kistna deltas with the southern districts of the province.

The Calcutta and Eastern Canal is in some ways a remarkable work; it runs through the upper margin of the Sundarban forests, where the land is generally below the very highest floor level, but has been reclaimed by embankment and is generally cultivated. A little nearer the Bay of Bengal the vast area of swampy land, which forms the Sundarbans, is covered with dense maiden forest. The canal runs generally east and west, while the various channels, or "gongs," as they are called, which are connected with the Bay of Bengal, run generally north and south. These gongs are all tidal, up to and, in most cases, a considerable distance beyond the canal itself, so that the general ebb and flow of the tide is more or less at right angles to the line of the canal. The main channels, however, are linked together by an intricate system of cross streams, which intersect the forests of the Sundarbans in all directions, so that it is always possible to find a way from one gong to another in a direction which is more or less east and west. The canal has, in fact, utilised a connecting system of cross channels between the main gongs to a large extent, but in some cases artificial channels have been made. In many of these connecting channels a great difficulty has arisen owing to the tides meeting in them. The tide makes up the main gongs on either side of a connecting channel at about the same time, and enters the east mouth and and the west mouth of the channel simultaneously; the result is that the inflowing tides meet at some point in the channel; at that point there is, of course, no flow. The waters in these tidal channels are heavily charged with silt, which is deposited very rapidly wherever the velocity of the flow is checked; consequently the canal silts badly at these meeting points, and heavy expenditure in silt clearance is involved.

The Calcutta and Eastern Canals have been greatly improved by Government at a cost of about £250,000 during the last 25 years, and the capital outlay on them has been more than doubled in that time. The results have been very beneficial to the traffic, but the financial results have not been all that might have been expected; this system used to pay 6 and 7 per cent., but now, partly owing to reduction in tolls, but mainly to the large expenditure in improvements, it only pays from 2 to 3 per cent. The traffic on it remains fairly constant in spite of the fact that the Bengal Central Railway, which was first opened in 1881, taps the same districts, and was expected to intercept, at Khulna, a great deal of the traffic of the canals. The tonnage of the canal traffic has been :—

	Tons.
Average of two years ending March, 1881	780,000
Average of three years ending March, 1896	1,094,420
Average of three years ending March, 1899	926,905
Average of three years ending March, 1902	1,018,439
In the year 1902-1903	891,414
In the year 1903-1904	960,600
In the year 1904-1905	1,240,000

These figures give the tonnage of the boats, but the actual weight of the goods carried is approximately half the tonnage of the boats. So that it may be said that these canals deliver about 500,000 tons of goods annually. The Bengal Central Railway has carried :—

	Tons.
Average of three years ending 1901	173,000
Average of three years ending 1904	192,000

Since the railway was opened in 1881, it has been worked at a gross loss of £400,000 to the State, after the interest, which is guaranteed by the Government at $3\frac{1}{2}$ per cent. on the capital, had been paid. In the same period, the Calcutta and Eastern Canals, taking interest at the same rate, had worked at a profit to the State of £25,000. This is a fair case in which a canal, working side by side with a railway, has held its own against the competition, and the example gives force to the contention that, under suitable circumstances, it is to the interest of the country that money should be spent on navigable waterways. In the last half century £235,000,000 have been advantageously spent

on the railway system of India: at the outside £5,000,000 has been spent on her waterways. The one is not too great, but the other is far too little.

It has been maintained that it is desirable, if not necessary, to make the trunk lines of an irrigation system navigable, in order that an easy and cheap means of carriage may be available for exporting the surplus grain and other products which irrigation produces. It has been stated that the development of irrigation is always more rapid when the main channels are navigable and that the expense of the additional work necessary, in order to make an irrigation canal navigable is not large, while the convenience to the people and to the officers in charge of the canals is very great. There is no doubt that, in some cases, notably in the Kistna and Godavery deltas, this is true. It is by no means easy to estimate correctly the difference in cost between an irrigation canal of a given capacity, and one of the same capacity which is suitable for navigation; the difference is by no means represented by the cost of the locks which have to be added at the canal falls.

There are several other causes which increase the cost. In the first place it may be necessary, in a navigable canal, to restrict the velocity of the water below that which the soil will stand. A velocity of more than two feet a second will perceptibly check boat traffic, and if the velocity is reduced it is necessary to have a larger channel and more frequent falls in the canal bed. In Madras, indeed, a velocity of 1·50 to 1·75 feet per second is considered to be the highest allowable under ordinary circumstances in a canal which is used for navigation. The reduction of the velocity may be very prejudicial to the irrigation canal, as it may cause heavy silt deposits. Then, as it is often necessary to impound the water in reaches of navigable canals at times of low discharge, it becomes necessary to increase the height of the banks and of the masonry works near the end of each reach; and, again, a navigable canal cannot be reduced in width in accordance with the discharge required for irrigation, so it is often necessary to make the canal in its lower reaches much wider than is required for the purposes of irrigation only; and, further, as frequent locks are to be avoided, in consequence of the impediment they offer to traffic, the reaches are lengthened as much as possible in a navigable canal, with the result that the volume of the earth-work, both above and below the locks, is greatly in excess of that which would be necessary in a channel designed for irrigation only. The height of all bridges has to be increased, with the consequent expense of long approaches to them. A certain quantity of water is consumed in passing the boats through locks, which is consequently lost for irrigation if the canal finally tails into a navigable river; this is a disadvantage which may be of some moment when the supply in the hot weather is scanty and very valuable for sugar-cane crops.

In the capital accounts of the irrigation works of India the cost of the navigation works is shown, but the figure only includes the cost of the locks and other works essential for navigation; it takes no account of the various elements of increased cost just mentioned. The actual cost of navigation works on the Bengal irrigation canals, and on the Sirhind Canal in the Punjab, was about £1,000 a mile; in the United Provinces it was only about £500 a mile. But it may be fairly estimated that, taking all things into consideration, the difference of cost between a canal designed purely for irrigation and the same canal adapted to navigation also, is from £1,500 to £2,000 a mile. The Buckingham Canal in Madras, which is for navigation only, cost about £2,000 a mile, and the Orissa Coast Canal about £3,000 a mile. The sum which appears in the accounts for the irrigation canals which have been made navigable is only £1,180,000, and the cost of the purely navigation canals has been £1,560,000; total, £2,740,000. But for the reasons just explained, the true cost of the navigable canals in India is probably double this figure—say, £5,000,000 sterling.

It must be admitted that this outlay, gauged by a purely financial test, has not proved remunerative. The following statement (Table II., p. 421) shows the receipts and expenditure under "Navigation" in the principal navigable canals in India.

The figures for expenditure are taken from the administrative accounts, and they may be termed the out-of-pocket expenses. It is impossible to divide the cost of maintaining the canals accurately between irrigation and navigation, and there is no doubt that if this could be done the expenditure column in this statement would be largely increased. However, taking it at its best, it shows the receipts 1903-04 to be (Rs.8,84,900) about £59,000, and the expenditure (Rs.6,72,500) about £45,000, or a profit of only £14,000 to the

TABLE II.—Financial Results of Navigable Canals.

	During the year 1903-1904.		From the commencement to the end of the year 1903-1904.	
	Receipts.	Expenditure.	Receipts.	Expenditure.
	Rupees.	Rupees.	Rupees.	Rupees.
Bengal:—				
Orissa Canals	70,400	21,800	29,90,800	8,20,300
Sone Canals	22,700	21,000	15,58,400	7,29,400
Midnapore Canal	47,200	9,600	33,60,800	6,58,200
Orissa Coast (including Tidal) Canal	76,700	87,000	27,93,800	25,81,000
Calcutta and Eastern Canals	3,98,300	2,63,100	2,69,18,100	1,14,40,400
Total—Bengal	6,15,300	4,02,500	3,75,61,900	1,62,29,300
United Provinces:—				
Ganges Canal	7,500	11,400	11,34,000	8,23,700
Lower Ganges Canal	5,600	6,300	1,43,100	2,56,500
Agra Canal	1,500	4,600	1,61,700	1,89,600
Total—United Provinces	14,600	22,300	14,38,800	12,69,800
Punjab:—				
Western Jumna Canal	56,400	8,200	not known.	now known.
Sirhind Canal	5,300	14,000	1,68,800	3,70,700
Total—Punjab	61,700	22,200		
Madras:—				
Godavery Canals	86,600	66,300	25,57,200	15,33,000
Kistna Canals	36,800	36,800	9,71,900	6,65,300
Kurnool Cuddapah Canal	900	10,500	55,900	4,90,100
Buckingham Canal	69,000	1,11,900	35,69,400	36,71,600
Total—Madras	1,93,300	2,25,500	71,54,406	63,60,000
Total	8,84,900	6,72,500	4,63,23,900	2,42,29,800

Government on the capital outlay of five millions. Since the navigable canals were opened the surplus of receipts over recorded expenditure has been (Rs.2,20,94,100) about £1,475,000.

There is one feature in this statement which must not be overlooked. It is that the purely navigation canals—that is, the Orissa Coast, the Calcutta and Eastern, and the Buckingham Canals—bring in more revenue than all the others combined. The fact points to one great reason why Indian canals are not financially successful. It is this. The lines which were constructed for navigation only follow, more or less, on trade routes; the lines which have been made on canals designed primarily for irrigation do not. It has been said that most of the navigable canals of India take off from a river which is not navigable, avoid all the large towns, and end in a rice field. Like many general statements this one only contains some truth, but the truth in it is large. It may consequently be said that it is not fair to judge of the prospects of navigable canals in India by the results which have been obtained on the canals which were primarily designed for irrigation. The irrigation canals which are navigable are useful to the people whose villages are near them, and, seeing that, taken collectively, the irrigation systems of India pay 7 per cent. on their cost, it should hardly be made a matter of objection that one function which they fulfil is not in itself directly remunerative to the State.

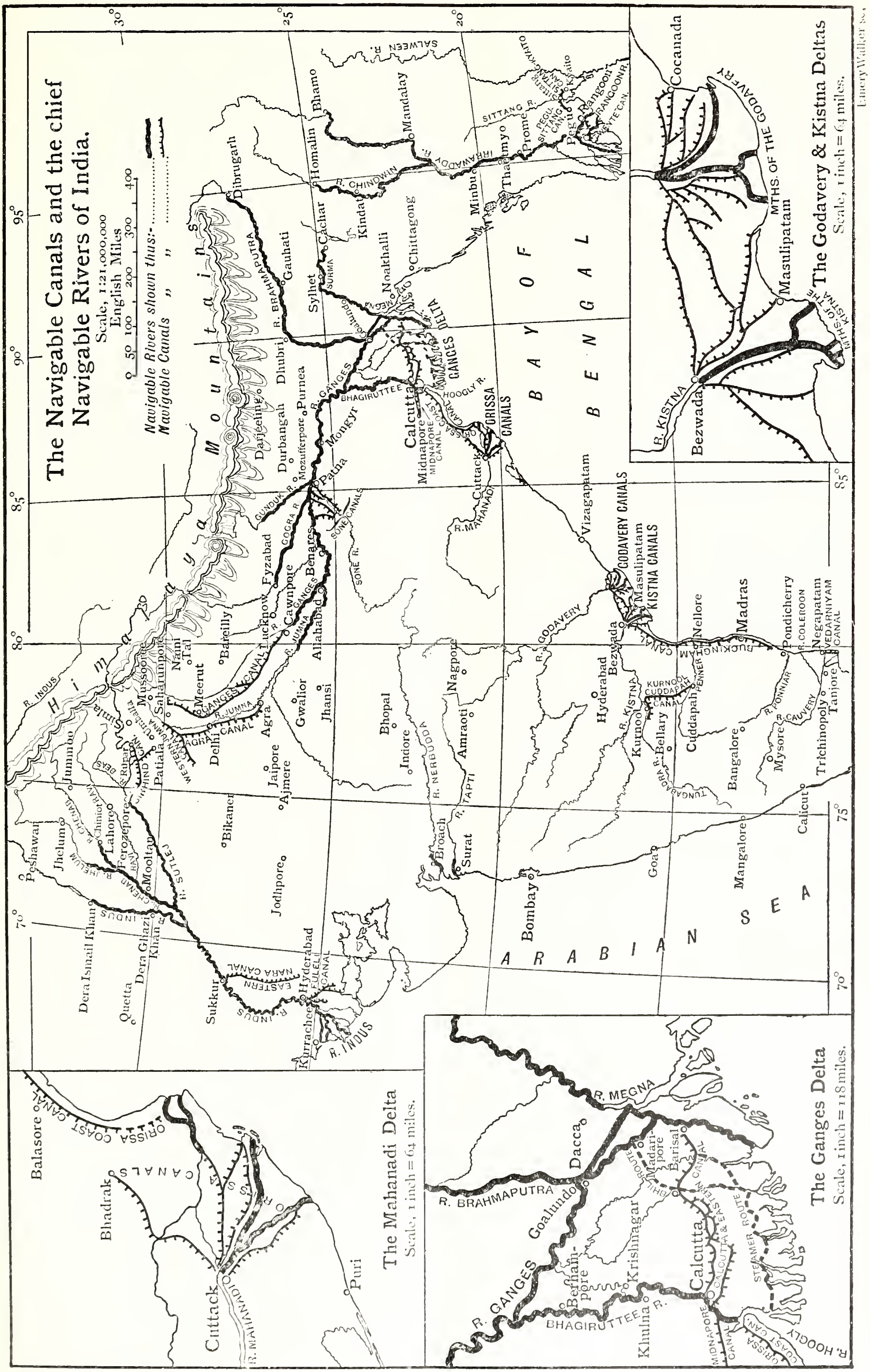
The traffic in Indian canals does not tend to increase. The following statement gives the statistics in the canals in Bengal and Madras:—

TABLE III.—TRAFFIC STATISTICS ON BENGAL AND MADRAS CANALS.

Canals.	Tonnage of Boats.					Toll Collections.				
	Average of three years ending March, 1899.	Average of three years ending March, 1902.	1902-1903.	1903-1904.	1904-1905.	Average of three years ending March, 1899.	Average of three years ending March, 1902.	1902-1903.	1903-1904.	1904-1905.
	Tons.	Tons.	Tons.	Tons.	Tons.	Rs.	Rs.	Rs.	Rs.	Rs.
Bengal:—										
Orissa Canals	401,600	244,100	202,900	259,500	325,200	1,52,900	89,300	68,600	69,800	68,200
Sone Canals	133,200	95,200	33,600	36,000	41,300	71,500	48,400	18,600	22,700	24,000
Midnapore Canal	446,300	360,100	279,600	217,800	248,500	1,30,000	92,400	70,500	47,200	61,100
Orissa Coast (including Tidal) Canal	459,400	287,800	223,800	261,000	304,000	1,64,700	94,000	69,900	70,700	70,300
Calcutta and Eastern Canals	926,900	1,018,400	891,400	960,600	1,240,000	4,01,300	4,04,300	3,58,700	3,77,700	5,11,300
Total Bengal Canals	2,367,400	2,005,600	1,631,300	1,734,900	2,159,000	9,20,400	7,28,400	5,86,300	5,88,100	7,34,900
Madras:—										
Godavery Canals	346,800	438,800	576,600	559,900	627,000	85,500	94,400	85,300	86,600	88,800
Kistna Canals	195,500(?)	631,200	487,900	281,600	460,600	36,800	40,300	46,000	36,800	38,800
Kurnool-Cuddapah Canal	2,100	3,000	4,500	2,800	2,200	1,400	1,300	1,200	900	1,200
Buckingham Canal	203,000	183,000	227,200	180,000	228,800	1,05,100	72,200	70,200	67,700	69,200
Total Madras Canals	747,400(?)	1,256,000	1,296,200	1,024,300	1,318,600	2,28,800	2,09,200	2,02,700	1,92,000	1,98,000

This table shows that there has been a greater reduction in most cases in the traffic receipts than in the tonnage of boats, which is explained by the fact that the tolls have been considerably reduced on several of the canals. There is no doubt that the reduction of the traffic on the four first-named canals in Bengal is due to the fact that the Bengal-Nagpore and the Mogul Serai-Gya Railways drew away a considerable volume of traffic. But the reaction has set in, and the canal traffic—partly, no doubt, under the influence of reduced tolls—is again increasing.

On all Indian canals tolls are charged on the boats which use them. The rates and method of charge vary considerably. In the Upper Provinces monthly or quarterly charges are made according to the size of the boat and irrespective of the distance it may travel. On the Fuleli Canal in Sind the same system is followed. In Madras, licences are granted which leave the holder free to navigate all parts of the connected waterways. In Burma, the tolls, charged on the navigable canals, are based on the carrying capacity of the boats expressed in buckets of unhusked rice. In Bengal tolls are charged on all canals according to the distance travelled by the boats; the average rate of toll in that province used to be from (2 to 3 pies) one-sixth to one-quarter of a penny per ton per mile on the boat measurement, which would amount to about a third to half a penny per ton per mile on the actual weight of goods; but these charges have been reduced lately to a lower figure. It has been urged that all tolls ought to be removed from Indian canals, and that they should be opened to the use of all in the same way that roads are. It is not strictly true to say that canals in all countries except England and India are free, but it is nearly true. During the last 30 years, in which India has spent about £5,000,000 sterling on navigable routes, France had spent six or seven times that sum on her waterways, and contemplates an expenditure of £20,000,000 more; Germany in the same period has spent some £15,000,000 on her waterways and has quite recently passed the Prussian Canal Bill, which contemplates the expenditure of some £17,000,000 more. Other countries, notably America and Canada, are improving and extending water communications at great cost. In France, in Italy, in Austria and Hungary (with the exception of the Iron Gates Canal), no tolls are levied on navigation; in Belgium and Germany, although tolls are charged, they are very low.


The Navigable Canals and the chief Navigable Rivers of India.
Scale, 1:21,000,000
English Miles
0 50 100 200 300 400
Navigable Rivers shown thus:-
Navigable Canals " "
Himalaya Mountains
BAY OF BENGAL
ARABIAN SEA
GANGES DELTA
ORISSA CANALS
GODAVERY CANALS
KISTNA CANALS
The Godavery & Kistna Deltas
Scale, 1 inch = 64 miles.
The Mahanadi Delta
Scale, 1 inch = 64 miles.
The Ganges Delta
Scale, 1 inch = 118 miles.
Emery Walker sc.

In the United States and Canada, nearly all the canals are free, only those which are not the property of the State being subject to tolls. In Egypt all tolls on canals and waterways were abolished in 1901. England and India are conspicuous among nations by the tolls they impose on water traffic, and it would seem that the time has come when the Government of India might consider whether it should not follow the lead of other nations of the world and leave the navigation of the canals as free as they leave the traffic of the roads. It is clearly a question which is open to argument, whether canal tolls are, or are not, justifiable in themselves; but it is also clear that the nation which places a toll on her waterways hampers her merchants in a way which does not occur in a country where all the canals are free of tolls.

Reference has, so far, only been made to the artificial waterways of India, but she has many natural ones. The rivers of India, which derive their supply partly from the snows of the Himalayas and partly from the rainfall on their catchment areas, are those which present the best facilities for navigation. In their case the snow, on the mountain tops, forms vast reservoirs, which are tapped in the hot dry months, and from this source these rivers obtain the supply which maintains their flow. Those rivers, on the other hand, which derive their flow exclusively from the rainfall on the snowless hills and the vast plains of Central and Southern India, have no reserves from which they can draw during the six or seven months when there is little or no rainfall. At that time they fall lower and lower, as surface drainage fails and springs are exhausted, until, in some cases, the river beds are practically dry. These are the main reasons why the natural waterways of India which are most serviceable for navigation are those which emanate from the Himalayas. The chief of these are the Indus, the Ganges, the Brahmaputra, and the Irrawaddy; while among those of the second class the chief rivers are the Sone, a tributary of the Ganges, the Nerbudda, the Mahanuddee, the Godavery, and the Kistna. It is perhaps hardly correct to describe any of these rivers, which are not snow fed, as navigable rivers at all, although there is at times a considerable volume of traffic on them. But all the rivers of India, whether snow-fed or not, rise greatly during the monsoon, when, for some four or five months, the rainfall is heavy. At that time, consequently, many rivers are navigable which are impassable for boats at other times, and the navigable length of superior rivers is considerably increased. The Kistna, for instance, which in the flood season may carry 750,000 cubic feet per second, dwindles, for three months in the year, to a small stream, wandering among sand banks, which carries only 100 cubic feet. In addition to the main rivers, there are, in many parts of the coast, and notably in the deltas of the Ganges, the Brahmaputra, the Irrawaddy, and some of the Madras rivers, innumerable channels, creeks, backwaters, and estuaries, which afford great facilities for transport.

There was, before the era of railways, much greater interest in India in the navigability of rivers, and special officers were, at one time, retained on the Ganges and the Jumna to aid in keeping the channels open. There were projects prepared in the "sixties" for rendering some 800 miles of the Godavery and its tributaries navigable, but, until quite recently, improvements in navigation have not commanded attention. Interest in the subject has, however, again revived, and it is beginning to be admitted in India, as it is already admitted in most other countries, that canals and navigable rivers are not antagonistic to the true interests of railways; that each can render a service to the other; and that the true policy is to encourage both in those particular localities where navigable waterways can be easily constructed, or existing waterways can be improved. This is particularly seen in the action now being taken in Bengal.

The Irrawaddy is the great highway of Burma. The river rises in the unexplored regions of the Himalayas where India, Tibet, and China meet. It flows for a thousand miles in a stream, broad and navigable, from the point where it emerges from its unknown and mysterious birthplace in the Himalayas down to the Bay of Bengal, into which it pours its mighty waters through a hundred mouths. In its northern reaches the river flows through mighty defiles amid scenery of much grandeur. It is navigable from the sea upwards, beyond Bhamo, to the confluence of the N'Maikha and the N'Mlekha, which are its two main sources of supply from the hills. From Myitkyina the river flows, from November to March, in a broad, clear stream, which, although majestic to the eye, is shallow, and the navigable channel in the upper reaches is not a broad one. But in the period of the monsoon, the upper courses of the river, among the narrow and circuitous defiles, are swollen with melting snow and heavy rain; the water

is said to rise, sometimes in a single night, as much as 50 feet, and then the current among the hills is a raging torrent in which no boat can live. The first defile is entirely closed to steamers from May to October, but country boats navigate it, with some danger. In the second defile, a few miles below Bhamo, when the river has left the great mountains, the channel is broader and little obstructed by rocks, and the waters are far less turbulent. Near the northern entrance to this defile is a great cliff rising abruptly 800 feet from the water's edge. The third defile is near the ruby mines, about 150 miles above Mandalay. The Irrawaddy is navigated for 900 miles by the steamers of the Mandalay Flotilla Company, which are not only the chief means of communication but are, also, the travelling bazaars for the villages on the banks of the river. The steamers leave Mandalay each week for Bhamo, and one of the flats towed by the steamer is generally divided into stalls in which merchants stow their wares and sell them to the villagers at every stopping place.

The delta of the Irrawaddy may be said to begin near Myanaung, where the influence of the tides is first felt: the rivers, or channels, in this delta, are similar to the Sundarbans at the mouths of the Ganges and Meghna, forming a close network of creeks navigable in all directions.

The chief tributary of the Irrawaddy is the Chindwin. Its source, like that of the great river, is unknown; it lies among the unexplored mountains to the north. It is navigable by shallow stern-wheel steamers, for almost 300 miles from its junction with the Irrawaddy. Native boats with large white sails, laden with produce, pass down it to the stations on the larger river. The navigation in the lower reaches of the Chindwin is rather hazardous at times and steamers, when the river falls, have to feel their way with care. The scenery in places is very grand, especially near the Shwezaye—the Golden Whirlpool—where more than one steamer and many small craft have been lost.

The Salween river is believed to rise in the Tibetan mountains north of Lhasa. It is in all probability actually longer than the Irrawaddy, but it is not to be compared to it in importance. It is a torrent, quite unnavigable except for short lengths between the rapids, walled in by banks varying in British territory from 3,000 to 6,000 feet high.

The Indus is navigable all the year round for steamers of moderate draft as far as Dera Ismail Khan, some 800 miles from the sea, and 250 miles beyond the Sind border on the course of the river, and small boats can pass up it as far as Attock, where the Cabul river joins it, and even to within 12 miles of Peshawur. At Mithankot, 450 miles from Karachi, the Indus receives the waters of the five Punjab rivers. Their waters have been extensively tapped to supply the irrigation works of the Punjab, and the draught has affected the depth of water in the rivers. The Chenab, Sutlej, and and Jhelum are all more or less navigable by small boats of two feet to three feet draft, but the Ravi is not. It may be said that the Chenab and Sutlej are navigable to Chiniot and Ferozepur respectively, but when the rivers are swollen by rain the currents are strong and are a serious impediment to traffic.

The chief traffic on the Indus is registered at Sukkur. The exports from the Punjab which pass down the river consist very largely of wheat. Out of 56,000 tons unloaded at Sukkur in 1904-1905 no less than 44,000 tons were wheat. The traffic on the Indus, on the average of the last four years, is expressed in the following table:—

	Tons.
Loaded at Sukkur for the Punjab	48,000
Unloaded at Sukkur from the Punjab ..	5,000
Loaded at Sukkur for Sind	4 500
Unloaded at Sukkur from Sind	12,000
River-borne trade at Kati Bundar	16,000

This traffic seems absolutely insignificant when it is remembered that something like 1,500,000 tons of wheat alone passes over the North Western Railway of India in a year, and that the river-borne trade on the Ganges and Brahmaputra is between 2,000,000 and 3,000,000 tons a year.

The Nerbudda is a river which is navigable in some parts, but its bed is greatly obstructed and the stream is strong. The navigation of the river is practically confined to the part of the river which lies in the district of Gujarat, and even there the navigation of the upper reaches is only possible in the flood season. Below Broach navigation is practised by vessels of as much as 70 tons. The river in this part is tidal. The traffic, both import and export, on the river was valued at 38 lakhs of rupees in 1904-1905.

The Tapti river, in Surat, is navigable for the last twenty miles of its course. It was at one time thought that this river might be made the highway for the carriage of the produce of Khandesh and the Central Pro-

vinces to the sea, and surveys were made, as long ago as 1853, to determine the question. But there are many obstructions on the river, and the project was abandoned. The import and export trade of the river was about 30 lakhs of rupees in 1904-1905.

The Godavery and Kistna rivers, in Madras, are navigable to a certain extent. The Godavery is navigable for shallow draft steamers 105 miles above the Dowlaishweram anicut (which is the weir across the river at the head of the delta) during the flood season, from July to November. When the river is low (from the end of October to June) it is often imposssible to navigate more than sixty miles from the same point. If certain works at Dumagudiem were repaired, it would be possible for steamers during the flood season to reach that place, which is 200 miles above Dowlaishweram, but the navigation would be hazardous in many places. Small boats, called *navas* of very light draft, can navigate the river during the whole year for 200 miles above Dowlaishweram. The Godavery river is connected by canal with the Kistna canals, and with the Kistna river and also with the Buckingham Canal.

The Kistna river is navigable by boats only in parts near the mouth of the river and for seven miles above the Bezwada anicut which is the head of the Kistna canals.

In Southern Bengal the Mahanadi river is navigable during the dry season for a few miles above the head of the delta at Cuttack, but, in the floods, boats can pass up it for 600 miles, although the navigation in parts is difficult. A considerable number of native boats pass down the river from Chutteesghur and Sumbulpore during the rainy season.

But it is in the north of the Bengal Province that the most important waterways of India are to be found; the service they render India is illustrated by the following statement, which is compiled from the "Report on the Trade carried by Rail and River in Bengal," published by the Director-General of Statistics :—

TABLE IV.—WEIGHT IN TONS OF MERCHANDISE CARRIED BY RAIL AND RIVER IN BENGAL IN 1903-1904.

	Into Bengal.		Into Calcutta.		Total Imports.	
	By Rail.	By River.	By Rail.	By River.	By Rail.	By River.
From British Provinces.	310,588	372,663	4,647,726	1,268,314	5,011,626	1,640,977
From Native States ..	37,535	—	15,776	—		
	From Bengal.		From Calcutta.		Total Exports.	
To British Provinces ..	1,021,016	97,905	726,085	512,872	1,795,155	610,777
To Native States......	44,458	—	3,596	—		

Total weight (in tons) carried by rail and by river respectively .. 6,806,781 | 2,251,754

VALUE IN RUPEES OF MERCHANDISE CARRIED BY RAIL AND RIVER IN BENGAL IN 1903-1904.

	Into Bengal.		Into Calcutta.		Total Imports.	
	By Rail.	By River.	By Rail.	By River.	By Rail.	By River.
From British Provinces.	5,66,64,888	2,51,16,264	39,88,38,593	17,46,61,215	46,20,72,567	19,97,77,479
From Native States ..	17,20,152	—	48,48,934	—		
	From Bengal.		From Calcutta.		Total Exports.	
To British Provinces ..	5,11,45,181	1,33,51,184	24,86,63,837	9,88,53,240	30,43,61,028	11,22,04,424
To Native States......	24,63,628	—	20,88,382	—		

Total value (in rupees) carried by rail and river respectively.. 76,64,33,595 | 31,19,81,903

The internal trade between Calcutta and all parts of India, together with that between Bengal (excluding Calcutta) and all parts of India, was valued in 1903-04 at about £72,500,000 sterling. This is the trade carried by rail, by river, and by cart; it does not include the greater part of the trade carried by canal. Of the £72,500,000, £51,000,000 were dealt with by the railways, about £21,000,000 by the rivers, and the rest went by cart. The trade carried to Calcutta by the canals is about £3,000,000 sterling a year. So that, speaking roughly, it may be said that one-third of the trade of Bengal passes to its destination by water carriage.

The domestic trade of the Bengal Province, that is, the trade from Calcutta to other parts of Bengal and from other parts of Bengal to Calcutta (which is included in the above figures), is about £45,000,000 sterling; that is, it is greater than the trade with all other parts of India put together. Of this domestic trade more than one-third is carried by river. These facts seem to show that the waterways of Bengal are of great importance from a purely provincial point of view, and are also important —though not so much so—from an imperial standpoint.

The waterborne trade of Bengal passes to and from Calcutta by several main routes. The trade of the United Provinces and Northern Bengal travels by the Ganges and its deltaic channels; that of Assam by the Brahmaputra and the Sundarban routes; that of Cachar and Sylhet by the Meghna, the Soorma, and the Sundarbans; that of Eastern Bengal by the Sundarban routes; that from Midnapore and Orissa by the Midnapore and Coast canals and the Hugli river, which is navigable up to Nadia. All these routes are navigable all the year round, and in the rainy season there are many natural channels, connected with them, which are navigable by boats, and even by steamers for some four months or so: many of these lead from the coast far up into Eastern and Southern Bengal. The Sundarbans are a vast network of tidal streams through which the steamer route from Eastern Bengal, which is navigable at all seasons, passes to Calcutta. The Ganges may be said to be navigable from Cawnpore to the sea: in the upper parts of this length the navigation in the dry season is restricted by sand banks. Its southern tributaries, the Jumna and the Sone, can be navigated with some difficulty in the rainy season but not in the dry season: its largest northern tributaries, the Gogra and the Gunduk, which are snow-fed, can be navigated all the year round by large boats and small steamers. The Gogra is navigated by steamers up to Fyzabad, and the Gunduk is navigable for some 200 miles from its junction with the Ganges. In addition there are many smaller tributaries which are navigable in the rainy season for varying distances from the main river. The head of the delta of the Ganges is at Rajmahal; at, and below that point, several deltaic channels threw off from the parent stream. The most important of these is the Bhagirathi, which, after following a winding course of about 120 to 140 miles from the main stream of the Ganges, joins the Hugli at Nadia.

The trade which passes between Bengal and the United Provinces, both eastwards and westwards is, approximately:—

	By Rail. £	By River. £
In 1900-01	12,400,000	1,600,000
In 1901-02	12,500,000	1,800,000
In 1902-03	13,300,000	1,700,000
In 1903-04	14,400,000	1,500,000

These figures do not include the trade which passes to Calcutta, by river from Patna, Chupra, and other centres in Upper Bengal. This trade would, if the Bhagirathi were open all the year round, certainly increase largely, and probably, with but slight diminution in the rail-borne trade. But the route by the Bhagirathi and the Hugli to Calcutta is only open during the rainy season; at that time there is ample water—20 and 25 feet—in the Bhagirathi. In the dry season this stream has, when at its lowest, only a few inches of water in places, although there are fairly deep pools of considerable length, lying between the bars which block all traffic except that which can pass in quite small boats. The Bhagirathi passes through the ancient city of Murshidabad and close to the battle-field of Plassey. In the dry season, when this route is not open, all boats and steamers trading with Northern Bengal have to go round past Goalundo, Barisal, and the Sundarban channels. The Bhagirathi route is 425 miles shorter than this one, a fact which clearly indicates its importance. Steamers with flats in tow have done the journey from Patna to Calcutta by the Bhagirathi in three and a-half days when running only in the day time. Many of the steamers now working in Bengal are fitted with electric search lights, and they could probably accomplish the same journey

in forty-eight hours, all the year round, if the Bhagirathi were made navigable in the dry season. There is a project now under discussion for doing this. It is proposed to dredge out the sand bars in the Bhagirathi bodily by three great suction dredgers, each capable of delivering through two 30-inch pumps, 3,000 cubic yards of sand per hour from a depth of 20 feet, and delivered by a pipe 200 yards in length to a height of 20 feet above water level. It seems a gigantic undertaking to dredge out the bed of a river for the greater part of a length of 120 miles to a depth of eight or ten feet, but there is reason to believe that the scheme is quite a feasible one, but it would cost a large sum. It would not only have the advantage of shortening the route from the Upper Provinces to Calcutta by 425 miles, but it would also bring into the Hugli river, in the dry season and in the rains, a much larger volume of water. This would be an advantage to Calcutta from a sanitary point of view, and it is not impossible that the increased discharge in the Hugli would improve the navigable condition of that river, between Calcutta and the sea.

Another project which is actually under construction, and in partial operation, is that known as Madareepore Bhil route. The present steamer route through the Sundarbans, which all steamers have to follow which go to Assam and Cachar, is very tortuous, and in one place known as the Angeria Creek, it is in danger of being closed by silt. The great Madareepore Bhils lie between the Mahdumati and Kumar rivers, a little to the north-east of Khulna. The ground in the Bhils is very flat, and some eight or nine feet below the level of the margins of the rivers. The rivers in the rainy season rise, so that the water level is, more or less constantly, for two months or more within a foot or so of the level of the river margins.

The Bhils at these times fill up mainly by rainfall, partly by influx from the rivers, to something less than the level of the water in the rivers. Hence there is for some two months about seven feet of water over the ordinary ground level. The result is a great inland sea some 15 or 16 miles broad and some seven feet deep. This sea is dotted over with little artificial islands of very small dimensions, on which the people perch themselves in their houses just above the water level. The sea is connected with the rivers by various khalls or channels by which boats can enter it.

If this inland sea were only an open expanse of water, steamers could navigate it in all directions. But it is not. The greater part of it is cultivated in rice, the rice growing with the rising waters. The eye wanders for many miles in September over an immense, and apparently boundless, plain of rice crops. Here and there, where the ground is lower than the average, there are no crops, and the water is covered by a pall of densely-matted weeds. Through this mat nothing can pass. Through the rice even, it is difficult for a steamer to travel. The long stems of the plants cling to the paddles, and the friction against the bow and sides of the steamer is not inconsiderable.

Through these great Bhils a canal has recently been excavated, from Haridaspur to Khalia, a length of about 25 miles. This channel is at present only navigable for steamers during the rainy season, but the Government of India has recently ordered a large dredger which will cost about £70,000, such as has been just described, which is to cut out a channel of sufficient width and depth to take large steamers through it all the year round. This route saves steamers from 40 to 135 miles on their journey to and from Calcutta and various points in Eastern and Northern Bengal. It is also an alternative of great value in case the Angeria Creek became choked. It may cost, including all charges, about £75,000.

Inland steamers passing from Calcutta to Eastern Bengal have now to go down the Hugli and through Channel Creek before turning eastwards into the Sundarbans. The head of the Channel Creek has lately depreciated greatly in depth. In order to save the great circuit which the steamers have to make by this route, it is proposed to cut a canal from the Hugli near Calcutta into the Mutlah river. Steamers would then pass through the canal and down the Mutlah to the Sundarban steamer route. This proposal, in connection with the Bhil route just described, would save steamers proceeding to Goalundo and Assam 266 miles, and those proceeding to Naraingang and Cachar 197 of their present journey. And not only that; on the present steamer route the waves are sometimes so high that it is not possible to load the flats to their full depth, and a larger number of boats have to be employed than would be sufficient to carry the traffic in the comparatively sheltered waters of the proposed route. This improvement has been under consideration, but no sanction has yet been given to it. The

cost has been vaguely estimated at £300,000, but it would probably be considerably more than that.

The Honourable East India Company was the first to organise steam traffic on the Bengal waterways, and the business was a very profitable one to the Government. In the time of Lord William Bentinck, in 1834, a regular line of Government steamers commenced to run between Calcutta and Allahabad. The first steamers were about 120 feet long and 22 feet beam. Now the traffic on Bengal rivers is worked by companies, which have large steamers and flats having an aggregate capacity of nearly 200,000 tons. The electric searchlight was first fitted to one of the river steamers, the *Nemotha*, in 1892, but now many of the steamers have these lights, and they navigate the rivers, on some routes, during the night. The India General Steam Navigation Company has done, and is doing, a good work in the navigation of Bengal rivers. This company was the pioneer of private enterprise in the inland waters of India; it was initiated at a meeting of "merchants, capitalists, inhabitants, and others, holden in Calcutta on the 6th day of February, 1844," and is still the chief among several companies which run steamers on the rivers.

The trade which passes between Bengal and Assam is, next to its own domestic trade, the most important which is served by the waterways of the Bengal province. The following statement, taken from the report of the "Trade Carried by Rail and River in Bengal," gives the approximate value of the goods passing to and from Assam and Bengal (including Calcutta) during the last four years:—

	By Rail. £.	By River. £.
1900-1901	900,003	6,200,000
1901-1902	2,200,000	4,400,000
1902-1903	1,800.000	4,700,000
1903-1904	2,500,000	5,000,000
Total for four years	7,400,000	20,300,000

Roughly speaking, one-third of the trade goes by the railway and two-thirds by the rivers. The river trade is largely carried in the flats and steamers of the navigation companies, and it has been a very profitable business to them. These profits are now reduced by the competition of the railways, but, as the figures show, the water-borne trade is largely in excess of that which passes on the railways. The Assam Bengal Railway runs from Chittagong, through Cachar, to Johat and Dibrughur; it will, in a short time, be connected with Calcutta, through the Eastern Bengal system, by a line running from Gauhati to Kaunia. The Assam Bengal Railway, while it is of great benefit and convenience, is worked at a heavy loss to the State. It has been constructed, and is worked by a company under a guarantee of 3 per cent. The capital expended on it at the end of 1904, was £8,400,000. After meeting the interest charges, the loss to the State on the working of the line was £93,000 in 1895, £200,000 in 1900, and £270,000 in 1904. This is the price which the State pays from the general revenues of India for the benefits which the railway confers. The lines of steamers which carry the Assam trade on the great rivers have no guarantee on their capital and receive no contribution from the State towards the sum they pay their shareholders. During the years on which £8,000,000 sterling have been spent on the construction of the Assam Bengal Railway the only important improvement made in the large waterways leading to Assam has been the Bhil route, which has cost about £50,000, and which last year brought in a direct net revenue of about £2,500 or 5 per cent. interest on its cost.

The returns from the Assam Bengal Railway will, no doubt, improve in time, and the reasons which determined its construction were probably, and perhaps wisely, largely independent of its immediate financial success. But it certainly seems wrong that, while railway companies so readily obtain free land and a Government guarantee on their capital, navigation companies get neither, and also find it so hard to induce the Government to spend anything on improving the waterways. This is the more noticeable, when it is remembered that, in all countries, other than England and India, such large sums are actually being spent on improvements to internal navigation.

It is most satisfactory to notice that the question of the improvement of the navigable waterways of India is now receiving some attention from the Government. Lord Curzon, just before his departure from India, in replying to an address on the subject, wrote that he had always been disposed to think that the claims of inland navigation in India were deserving of somewhat greater sympathy at the hands of the Government than they had received, and he stated that one of his last acts had been to review the entire matter with a view to initiating a more liberal policy in the future.

DISCUSSION.

The CHAIRMAN said he was sure that, whatever differences of opinion might manifest themselves in the course of the discussion in regard to matters of policy, they were all agreed that a debt of gratitude was due to the author, who had placed such a mass of information before them in so lucid and interesting a manner. No one who reflected on the relation which always existed in a community, between the means of transport or locomotion, whether of goods or passengers, would for a moment doubt how vital a bearing waterways and railways had on the economical, social, and political position of a great country. He was very glad to hear the author make a remark which applied also to the British Isles, that there was, and need be, no natural antagonism between railways and canals. When the facts of the case were looked at, and one appreciated the enormous area of the great dependency of India, with its hundreds of millions of people, and remembered that the 5 feet 6 inch and metre gauge railways amounted to less than 30,000 miles, and the canals to only a little over 4,000 miles, one must be struck with the disparity which existed between area and population on the one hand and the means of transit on the other. That brought him to a question of policy, which was the last field into which it would be proper for him to enter that afternoon. There was an old story of a Pope of Rome who was visited by a traveller, at the Vatican. He inquired how long the traveller had been in the city, and on receiving the reply, "Two or three days," said, "Oh, you know all about it then; you have nothing more to learn!" He had spent "three days" as it were at the India Office; and, therefore, on questions of policy he intended to say nothing whatever. He was present as a learner, and in that capacity desired to express his grateful thanks to the author for placing such a body of information at their disposal

Mr. SIDNEY PRESTON, C.I.E. (late Inspector-General of Irrigation, India), said he did not think there was much scope for artificial navigation channels except in connection with certain of the natural waterways such as the Madaripur Bhil route, or the channel from Samokpatha to Calcutta, which were referred to in the paper. He did not think that artificial navigable canals could compete with railways in the interior of the country, or that it was worth while making our large irrigation canals navigable. The people in the tracts irrigated by the large perennial canals are not aquatic, and are, therefore, not used to boats or boating. They must maintain their plough ullocks which are available—when not needed in the field—to cart produce to the markets or the railway. Even in regard to the natural waterways there are only three or four places in which he thought much could be done. These places are:—(1) Eastern Bengal; (2) Burma; (3) The Ganges; (4) The Indus. Mr. Buckley had detailed a few other places in which there is some navigation, but it is confined to country boats and is not of very great extent. It is also questionable whether, with railways along both banks of the Ganges and the Indus, it will now be worth while spending large sums in the development of navigation on them. The cases of Eastern Bengal and Burma are, however, quite different. He had never visited the latter province, so was unable to speak from personal knowledge of its needs. But in the spring of 1903 he was enabled to take an eight days' trip by steamer along the Sundarbans route to Naraingunge and Chandpur, and it seemed to him that this district is one designed by Nature to be developed by its waterways, and that railways might suitably have been kept out of it. Yet the money so far spent by Government on these natural channels, or on artificial channels connecting them and leading to Calcutta, has been infinitesimal. He believed he was correct in saying that Government do not even maintain a regular staff to clear them of snags, fallen trees, &c. He was told that the Forest Department has a certain number of snag boats, and is nominally responsible for removing obstructions, but that it generally devolved on the establishment of the steamer companies to borrow the boats and clear the channels. If this is the case, he ventured to think that this is not as it should be, and that the maintenance of these trade routes should be an important duty of the State, and that provincial funds should be liberally given to keep these channels in efficient order. The author had referred to two schemes for improving the water transit to Calcutta. One is the opening out of the Bhagarathi; and the other, the improvement of the outer boat route by the construction of two artificial channels. He (Mr. Preston) had never had an opportunity of seeing the Bhagarathi, but it seemed to him extremely doubtful whether it will be possible to dredge and maintain a channel—120 miles long—on it. It has repeatedly been said that the Hugli would silt up, and fears have been expressed as to the stability of the port of Calcutta; but, as a matter of fact, we see that year by year the trade increases, and larger steamers come up and down the river safely. Last year, a 14,000 ton boat—the largest yet to enter the port—was brought up fully loaded. Instead of the river below Calcutta deteriorating, it is therefore actually improving, which is probably due to the action of the screws of the steamers. Now, even if the Bhagarathi could be opened by dredging, it is questionable whether the traffic will be sufficient, or of a class, to maintain it. Much of the traffic will consist of flats or paddle steamers, which will cause little or no action on the bed of the channel, and he would fear that it will have to be maintained in the same way as it will have to be cleared. It will be a matter for the serious consideration of Government whether the traffic will justify such recurring expenditure. The second scheme, which consists in cutting an all year route for steamers and flats through the Madripur Bhil, and the improvement of the Tolly's Nullah so as to give a direct route from Samokputta to the

Hugli, seemed to him eminently sound and practical. The former has been accepted by Government and is now under construction. The latter has been accepted as advisable, but the Government are shying at the great cost. Moreover, the Government of India hold that it is a purely provincial affair, and have so far declined to sanction an Imperial contribution for it. It is somewhat difficult to say what is a provincial and what an Imperial matter. It is often a matter of opinion. The Assam-Bengal Railway might easily be held to be a provincial affair, as it will develop a small portion of the country only, and the rest of India will not benefit directly by it. Yet it has been constructed from imperial funds. Many other similar instances could be quoted. In his opinion the development of the trade routes to the capital of the country is a matter of Imperial importance, and is one which the Imperial Government should undertake or finance, and he believed that indirectly the country would benefit by the construction of this navigation link. If the Imperial Government do not finance it, it seems extremely doubtful if it will ever be made, as the Provincial Government will probably be unable, or unwilling, to bear the loss in working, as it is questionable whether any tolls which could be levied would pay the working expenses and the interest on the capital cost. This naturally leads to the question of tolls to which Mr. Buckley has referred. As he says, there may be a good deal to be said on both sides of the question; but where every other civilised nation has freed the waterways the same as the roads, and are continuing to spend large sums on them, he (Mr. Preston) ventured to doubt if we are right in maintaining tolls. It has been urged that as the railways are mainly owned by the State, it would be absurd to use State funds in constructing canals free from tolls to compete with them. In Germany, however, the railways are owned by the State, and yet large sums are being spent on canals on which the tolls are very small; and in most other countries no charge at all is made. Is it reasonable to think that we alone of the civilised nations are right in this matter? He ventured to think that waterways are on all fours with metalled roads, and, as we have freed them, we should also free the waterways. He felt certain that in any civilised country in the world the scheme for improving the Tolly's Nullah to give direct access to Calcutta, to the magnificent fleet of steamers and flats of the Navigation Companies, would have been carried out long ago; and he still trusted that the Government of India will see their way to finance it with or without the levy of tolls. It would not be difficult to enlarge on the dangers and risks of the route through Steamer Channel from the Mutlah to the Hugli referred to in the paper.

Mr. S. M. MITRA desired to emphasise the amount of good irrigation works had done to the peasants of India. Eighty per cent. of the population of India were devoted to agriculture; therefore, irrigation was a considerable factor in their prosperity. It had been well said that water was the greatest treasure of India, and the waterways of India might be regarded as the national banks, on the perpetual credit of which depended the prosperity of 300,000,000 of people. Even railways were not such preservatives against famines as canals. Under the British rule many uninhabited deserted tracts had been turned, as if by the magician's wand, into fertile, populous, and thriving villages. The Cromer-Barbour inquiry of 1882 put the average annual income in India at Rs.27, or 33s. 9d. per head; but, thanks to British enterprise, the income of the peasants near canals had gone up considerably. For instance, the Godavery ryot, now owing to canals, earns annually £1 per head more than he did before. His income will increase still more, for river water is much better than well water, because it perfectly renews the soil and is considerably cheaper. Something yet remained to be done in order to make the best use of Indian waterways. A regular boat service is very much needed. The jute industry of Bengal often suffers for want of proper steamer service. For instance, at Singhia station on the Central Bengal Railway the river is often blocked with country boats laden with jute. The primitive country boats do the journey in five days. Any steamer company could easily run up flats to the jute centres and carry the jute cargo in a day to the nearest railway station. What is wanted is more British capital and more British enterprise to take full advantage of India's navigable waterways.

Colonel Sir COLIN SCOTT MONCRIEFF, K.C.S.I., K.C.M.G., said that he was an old irrigation man, and thought more about that subject than navigation in India in the old days. In the early sixties he remembered Sir Arthur Cotton, the great apostle of navigation, coming up from Madras to the north-west of India, and preaching to them there that they were neglecting their opportunities and ought to make all their canals navigable. They took his words to heart, but he thought the cost which had been incurred in trying to make the canals more navigable by means of high bridges and locks and all the other appliances was, in general, misspent. In future, if it was necessary to have navigation canals, they ought, especially in the Punjab and the United Provinces, to be made entirely separate from the irrigation systems. He could say very little indeed with regard to the rivers of India. Sir Charles Hartley did wonderfully good work at very small cost in making the Danube navigable, and he did not know whether similar means might not be adopted in India.

Mr. A. YUSUF ALI, I.C.S., thought the question of navigable canals as distinguished from irrigation canals largely turned upon the value of the internal and local trade of the country. He believed that

hitherto in all discussions on navigable canals, attention had been mostly focussed on the question as if it were a purely Imperial one. If it meant the construction of gigantic undertakings like the Suez Canal, or the Kiel Canal, or the canals in France, he could perfectly well understand that they would be Imperial undertakings, and perhaps the question in the abstract of charging tolls or not would be one for the Indian Imperial Government to decide. It was well known, however, that the Imperial Government had so many demands upon its purse that even if a cut-and-dried scheme was presented, it would be years before the funds were forthcoming. What he wished to urge was that navigable canals principally served the purpose of transporting very heavy bulky merchandise, such as timber and coal, for which the mills could afford to wait; whereas in the external trade time was a very important factor, making the railways a very successful competitor against the canals. With regard to interior or local trade, he thought there were cases in which it would be distinctly desirable to make a little canal instead of a road. In a locality, for instance, like Gorakpur, in the United Provinces, the north of the district was scarcely served by roads at all. This was not because there had been any neglect of the interests of that part of the provinces, but simply because it was impossible to maintain roads there. The district was very near the Tarai, and the moisture was so great that any road which was made was nearly swamped in the rainy season. A canal right across that area would be an ideal thing. Whether such a canal could be made was a question for experts to decide. But if a canal or series of canals could be made between the Gogra and the Gandak, a distance of less than 200 miles, they would serve a tract of country where rice was grown to such an extent that it might form the granary of three or four districts. Half-a-dozen or a dozen similar schemes taken up and urged from the local point of view, with the expenditure voted either by the Provincial Government or the District Board, would, he thought, be an advantage. The question of supplying local needs by navigable canals was, he considered, far more important to particular communities, and gave more promise of success than the advocacy of more ambitious schemes of transport.

Mr. A. SIMSON said the author referred to Channel Creek, which was the entrance from the Hugli to the Sundarbans and to the whole of Eastern Bengal, and called attention to the fact that that creek was silting up. According to the report made in 1904 the channel then had decreased from 26 feet to 6 feet of water and was still getting less. He did not think that either the authorities or the commercial community realised what that meant. It meant the closure of the Hugli to Eastern Bengal altogether, except by way of the Bhagirathi, which was only open in the rains.

Mr. HAROLD COX, M.P., was sorry to say he disagreed with the author's conclusions. There was a sort of feeling current at the present time in favour of spending large amounts of the taxpayers' money in order to provide waterways which the public did not want, or at any rate which the public did not want sufficiently to pay for them, which after all was the test. He noticed that everybody who advocated the construction of canals always wanted them constructed with the taxpayers' money, and always wanted them to be worked without a toll. Why should not the same principle be applied to railways also? A railway was even more useful to the public than a canal; therefore, construct it with the taxpayers' money, and allow everybody to use it free. It was always possible to get plenty of money subscribed with which to build a railway, but nobody would subscribe a penny towards the building of canals. An appeal was always made to the Government. People had pointed to France and Germany, which spent large sums of money on their canals. In France that was done because the French Parliamentary system was such that it was to the interest of the electorate and the elected to spend the public money on local improvements or non-improvements. He had particularly noticed what the author had said with regard to making irrigation canals navigable, and had been very much interested to hear Sir Colin Scott Moncrieff's remarks on that point. The author's argument was that irrigation canals paid 7 per cent. on the average, and that if they were made navigable it would be an advantage to the local villagers. Doubtless that was so, but at what price was that advantage bought? It was bought with the money of the general taxpayer, which was absolutely wasted, because he obtained no return for it. He had been asked why make any roads. The difference between roads and canals was that on a canal a toll could be levied on the people who used it, but on a road that was absolutely impossible. Tolls on roads were found so inconvenient that they had to be given up. There was no practical inconvenience in collecting tolls on canals; and, therefore, the principle that was applied to everything else should apply to canals—namely, that those who wanted them should pay for them. If that principle was accepted he did not think so many canals would be made. In Eastern Bengal there were natural waterways which could be developed at little cost, and produce a very great advantage to the people for a small expenditure of money.

Mr. ARTHUR LEE said that as the author of a paper read before the Society of Arts a few months ago on British Canals he was very glad to be present if only to hear the last speaker and to make a few remarks in reply to him. Mr. Cox was evidently not a manufacturer; he was an excellent theorist, but did not know the practical difficulties under which the manufacturers of the country were labouring. France and Germany had spent such a large amount of money upon their canal systems because they wished to

improve the trade of their respective countries. The evidence adduced from all quarters was that if canals did not pay *per se* they did pay in the increase of the value of the land which was served by them, and the greater prosperity of the industries close at hand. A case of that kind was to be seen in this country in the Manchester Ship Canal. It had been a financial failure as far as the canal itself was concerned, but the people of Manchester were eminently satisfied with the money they had spent, because an enormous number of industries had sprung up in the neighbourhood of Manchester which would never have been started otherwise. Mr. Cox had urged that the practical test was whether people could be found to supply the money privately in order to provide canals. It must be remembered, however, that the reason why people were disinclined to invest money in canals was that the moment such an undertaking began to be prosperous, the railway company came along and cut their charges, making up the loss thereby by increasing their charges at points where there was no competition. For example, the Severn Canal was vastly improved, and there was a prospect that the traffic from the Bristol Channel ports to the Midlands would very largely increase. But the railway companies cut their rates between the Bristol Channel ports and Worcester to such an extent that no increase in the canal traffic resulted. It was reasonable, therefore, to suggest that a local authority, or the Government, should provide money for the improvement of a waterway, if the railway company so reduced their rates that the community benefited. What was taken out of one pocket was put into another. But the great point, after all, was that railways and canals were not antagonistic. They were all delighted to know that the present Government had expressed its intention of appointing a Royal Commission to deal with the subject, and he hoped nothing would be said to prejudice that proposal, because it was one upon which the country needed light, and he believed public opinion would have it. Mr. Cox had so moved him on a subject which he had greatly at heart that he hoped the audience would kindly excuse him if in the short time allowed him he had only replied to that gentleman, and had not discussed the question in general.

Mr. R. B. Chapman, C.S.I., said that more years ago than he cared to reckon he had much to do with the administration of the finances of India, and since he returned home he had had a good deal to do with the Steam Navigation Companies in the Ganges Delta. When a friend put a question to Sir Richard Strachey in his new character as manager of a railway, he took a very different view to what he used to do when he was in the Government of India, and said that circumstances altered cases. He, therefore, could not quite say what he should have done when he was Financial Secretary, in regard to the canal problem. It was always before him during the twelve years he was in the Financial Department that the Government of India had not unlimited funds at its disposal, and that the money it had must be distributed according to the best of its abilities. Whether he should have been wise enough to have spared something for the navigation canals of the country he could not say. He agreed with one of the speakers who said that the canals in the interior of the country might be left alone at present. He doubted, as matters stood, whether navigable canals in the Punjab and the other inland provinces would be an advantage; but there were magnificent waterways in the great Ganges Delta; and when it was remembered how very much could be done with a small amount of money to improve them, and when one considered the density of the population and the bulkiness of the produce that had to be moved on those waterways, he did not think that the Government could be satisfied that it had done all it ought to do for that magnificent asset of the Province of Bengal. He was extremely glad to hear of Lord Curzon's acknowledgment that enough had not been done for the waterways of Bengal. If the project of deepening the Bhagirathi was not to be taken up at the present, he thought it was a pity, because it was a most promising enterprise, and might greatly improve the river Hugli, about which disquietude was often felt. It was gratifying to hear that the Madaree Bhil project was being taken up, and he hoped the canals into Calcutta would also be taken into consideration. If the waterways from Calcutta into Eastern Bengal were improved, he was quite sure the cost would be repaid a thousand times in the facilities which would be given for commerce and trade. The Government had done little or nothing for the river traders in that respect, but had done much to discourage them by spending £8,000,000 on the Assam-Bengal Railway, on which hundreds of thousands of pounds a year were now being lost.

Sir Hanbury Brown, K.C.M.G., said that the Bhagirathi river, the project for dredging which had been referred to by the author, was an old acquaintance of his. Twenty-three years ago he lived on the banks of the Bhagirathi, and was the officer responsible for maintaining the river as a navigable channel. The Bhagirathi was one of three rivers known as the Nuddea rivers, which afford short cuts from the Ganges to Calcutta on the Hugli. It was the duty of the executive engineer of the Nuddea rivers division to keep a channel open during the summer months along one of those three rivers. It was done by contracting the channel as the water fell, so that a minimum of 3 feet depth was maintained throughout the summer. By the end of the summer the channel had been sometimes narrowed to 30 feet, and even then it was not always possible to keep 3 feet depth of water in it. In his time the Bhagirathi was not the river chosen as the most favourable one for keeping open the summer channel. It laboured under

the disadvantage of a clay bar across the mouth that drew in water from the Ganges. In order to admit water into the Bhagirathi in the summer of 1884 cuts were made by hand through the clay bank; and as there was no dredger available for deepening the channel below water, it had to be deepened by coolies standing in the water and scraping the bottom with their *kodalies*. Working under those conditions, a coolie could not do even as much as a cubic yard a day. It was now proposed to introduce a fleet of dredgers which would do 100,000 cubic yards a day, dug up from a depth of 20 feet, lifted to a height of 20 feet and transported to a distance of 200 feet. Certainly the world moved on. Twenty-five years ago a junior executive engineer was always put in charge of the division, as nobody cared how it was managed, and whether the navigation channel was kept open or not; but now, as the author had said, a new attitude was being adopted towards navigation in this and other instances. It seemed an extraordinary thing to him that Britishers, who prided themselves on ruling the waves and in dominating ocean traffic, should, in the matter of inland navigation, be a good last among the progressive countries of the world.

Mr. W. MARTIN WOOD thought the author was to be cordially congratulated on his paper, which recalled attention to a much neglected subject, and one that was of immense importance to the economic condition of India. It was needful that navigable canals should be extended, and river courses improved because of the immense size of India, the long distances over which commodities had to be transported, and the necessity of that being done at the lowest possible rate. It was a question of infinite importance to cultivators, labourers, and export traders; and now that the subject had been ventilated he trusted it would be followed up to a much larger extent than suggested by other speakers, who had dealt too much in details on the present waterways. He was exceedingly glad to hear the author say that the Indian authorities were looking seriously at the matter instead of giving it the cold shoulder as hitherto.

Mr. C. W. ODLING, C.S.I., M.Inst.C.E., said that one of the speakers had referred to the labour of collecting tolls on roads as being greater than similar labour in collecting tolls on canals. He had lived in India for a very long time, and was not able to confirm that statement. Another speaker had referred to the possibility of small canals being made for inland traffic, but he thought the particular canal specified would probably cost a good deal more than a first-class railway. At the same time he thought several of the distributaries might be adapted to canal traffic. For instance, on one of the distributaries of the Midnapore Canal a number of small locks had been made because it was very difficult to make roads. A number of small waterways, say ten or fifteen miles long, might bring the crops of the irrigated area to a main road or railway. That principle had been adopted on one distributary, and boats which carried probably ten times as much as a cart conveyed the goods at about a fifth of the cost. He entirely agreed with the author in the appeal he had made that more money should be spent on navigation, especially in districts near the coast.

Mr. G. C. KILBY said that as an illustration of the advantage of waterways with a good minimum depth he desired to give a few figures. Some of the steamers, a photograph of which had been shown on the screen, when equipped for service, boilers and bunkers full, but with holds empty, drew 3 feet $2\frac{1}{2}$ inches. At 3 feet 11 inches they carried 100 tons; at 4 feet 6 inches, 190 tons; at 5 feet, 265 tons; at 5 feet 6 inches, 345 tons; and at 6 feet, 422 tons, so that every inch of water over $3\frac{1}{4}$ feet allowed a steamer to carry 13 tons more of cargo. Inasmuch as the cost of running the steamer was just the same whether it was carrying 100 tons or 400 or 500 tons, the effect of not cutting a channel through the shoals and sand banks in the Ganges and Brahmaputra was to diminish the usual depth of water in the stream which was 10 to 20 feet, to perhaps 4 feet, and proportionately to diminish the carrying power of the steamers. Therefore, a little deepening of the sand banks on the Ganges and the Brahmaputra would mean that all the steamers would be able to carry several hundred tons more than they would otherwise be able to do. What that would mean to the traffic of the country and to the rates charged was obvious. A steamer that could only carry 100 tons must charge a rate to pay for its working at the rate of 100 tons carried; but if the same steamer, for the same charges, could carry 500 tons, it was obvious that the freight which it could charge for the 500 tons would be diminished by three or four times the amount for each ton. Consequently the effect of even slightly cutting away some of the sand banks might be of enormous importance to the trade of the country. That, in a way, met the argument that there was no benefit in canals. As there could be very little trade in any country without roads so a bad road was better than none, and the best road possible was the best for the country; and the Government should try to provide it. For carrying bulky produce long distances the experience of the world had shown that the best road of all was a waterway of a good minimum depth on which large modern steamers could ply. Nature in that respect had been more bountiful to Bengal than to almost any other country, but in perhaps no civilised country had the Government neglected their rivers as had the Government of Bengal. America and Germany had utilised and improved their rivers, and made them capable of carrying an enormous quantity of goods at a very cheap freight, and the trade of those countries in consequence had prospered to an enviable degree.

Lieut.-Colonel ALLAN CUNNINGHAM, R.E., wished to emphasise the fact of the extreme difference of two parts of India in connection with waterways. The first was in the deltonic regions, which seemed eminently favourable for navigable waterways; the second was the whole of the upper north-west of India, where water was the life of the country and was wanted as the first necessity for producing crops. The Government, therefore, voted money first of all to the latter object and afterwards for purposes of navigation, which were not so absolutely essential. He was in complete agreement with Sir Colin Scott Moncrieff that irrigation canals as they had to be constructed in the north-west of India could not be made suitable for navigation. He lived for many years on the banks of the largest canal in north-west India, the conditions of which were much the same as on the other canals. An irrigation canal must be carried along the watershed of the country, in order that it might be able to irrigate the country on both sides. The towns however, were built not on the high, but on the low ground; the canals, therefore, not being near them, were most unfavourably situated for serving the towns for navigation purposes. There was also a physical difficulty in the way of utilising these canals for navigation, viz., the high velocity in so many of them in the North-West, frequently $3\frac{1}{2}$ feet a second. With such a speed it was most difficult to tow native craft by coolie labour; it would have to be done by steamers; this would cause a new difficulty, viz., the excessive wash against the sides of the canals, which would, therefore, cost more in up-keep. The money which would be required for making canals in Upper India suitable for navigation would be very great, probably more than the advantages which would be derived thereby were worth.

Mr. D. N. REID said he was an indigo planter, and was old enough to remember when indigo was sent down to the towns by country boats. In Upper India the planters required food for their cattle and manure for the land; and if in Lower Bengal and India generally the fisheries were properly developed that manure would be supplied, also oil for curing the hides of the cattle. Nothing would tend to supply this want more than the development of the waterways of the country, many of which could easily be canalised, and he quite agreed with the author that no tolls should be charged for their use.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Buckley for his valuable paper.

Sir CHARLES CECIL STEVENS, K.C.S.I., on behalf of the Committee, expressed their thanks to the Chairman for presiding. It was a great disappointment to the Society that Mr. Morley had not been able to make that meeting the first public occasion on which he had appeared in connection with Indian affairs, but it was a great satisfaction to them that Mr. Ellis had been able to snatch time to occupy the Secretary of State's place, and they were much obliged to him for doing so.

The CHAIRMAN said it had been a great pleasure to him to be present, and the meeting terminated.

Mr. A. SIMSON writes:—At the discussion which took place yesterday evening on Mr. Buckley's paper on the "Waterways of India" I was sorry that, owing to the exigencies of time, I was unable to claim a further hearing with reference to some of the remarks which fell from the speakers who took part in the discussion after me. I noticed especially the statement that whilst money was obtainable for railways by private subscription, whenever it was a question of waterways demands were always made upon Government to find the means for their development. It is true the speaker at the end of his address excepted from this dictum the waterways of Bengal. Now, I would like to be allowed to point out that however aptly what was said might apply to the United Kingdom or to other countries it does not apply to India. It is a matter of notoriety that one of the most difficult problems the Government of India has to face is the fact that private capital is not forthcoming for its railways without substantial subsidies and guarantees being offered for it. The improvement of waterways stands on an entirely different footing. I speak of them only in regard to navigation and not irrigation, and I would wish it to be understood that I refer only to that most important part of India for navigable waters, namely, Bengal, Assam, and a portion of the United Provinces. It can hardly be expected that the great natural waterways, namely, the rivers of these enormous districts, should be improved by private enterprise. In the case of a railway, if private money is put into it, and indeed in any case, the railway at least has a practical monopoly of the use of its own line. This can never be the case with a river, which is a natural and public highway open to all and every comer who chooses to make use of it. When I had the opportunity of speaking at the meeting I purposely said little—firstly, for the reason that I considered Mr. Buckley's paper self-contained and complete in itself, and, secondly, because I felt that anything I might say from my platform of interest in the pursuit of inland navigation might seem narrow compared with the broad scope of Mr. Buckley's address. I would like to say, however, that the industry I represent has done an immense deal of work at its own cost in improving the channels of the rivers, which has been not only to its own benefit but to the benefit of its competitors on those rivers and of the public generally. When it asked Government to open out new channels, in order to economise distance and promote cheaper carriage, it has invariably been confronted first of all with estimates to

show whether an adequate return would be forthcoming on the capital outlay to be incurred by Government. Mr. Buckley cites an interesting case in point concerning precisely the regions to which I refer. He points out that only £50,000 in recent years has been spent in improving one of the waterways, and that this gave a minimum return to Government of over five per cent.—from the tolls. Let us contrast this with what Government did in regard to the construction of a certain railway serving the same districts. That railway has involved a capital outlay of some £8,000,000 sterling, a considerable portion of which has been supplied by Government. The loss to Government out of public funds has so far amounted to £2,000,000, and this sum is likely to go on increasing. The lesson to be learnt from this is obvious and needs no further comment. Mr. Buckley states in his paper that the pursuit of inland navigation by the companies referred to has been highly profitable. I may acknowledge that for periods it has been so. But the companies have gone through very great vicissitudes owing in a great measure to the inequitable laws and conditions under which they have had to work. At times they have gone through protracted periods of very great difficulty, with an entirely inadequate return on the capital invested. The position they take up, however, is not that of asking for guarantees or subsidies. They do not want these, and are quite ready to continue diligently improving their services to the public if they only get *equitable laws* and *water*. With the provision by Government of those two commodities I think I can undertake to vouch on their behalf that they will give the country the inestimable boon of cheaper transport than it has ever known before, and by means of which the country itself and the Government must surely profit.

Mr. W. Martin Wood writes:—The discussion on this large subject did not quite rise to the level of Mr. Buckley's comprehensive and well discriminated survey of the question. That is, there seemed no adequate conception of the special economic and industrial importance to modern India of inland water transport.

The principle governing that method of inexpensive transit may thus be stated:—The essential link for securing the utmost facility in the exchange of the surplus products of one country with those of another, consists in reducing the cost of transport to its lowest practicable limit. This condition is of the greatest *relative* importance where the inland distances along which commodities have to be moved are the longest; and where those products are heaviest, most bulky and cumbrous in proportion to their pecuniary value; also in those countries or provinces, where the populations, being poor, the net return from ultimate sale of their export products becomes of the greatest relative value to the actual producers—that is, in this case, to the cultivators and labourers in the remote land-locked provinces of India. Here is one illustration that may serve:—

When the Scott-Moncrieff Commission sat at Bangalore, it was shown, by an experienced and competent engineer, that, besides perennial supply for the huge Tungabudra reservoir, there is also abundant supply of superfluous flood-water that could be made available for establishing an effective system of continuous navigation, from Bellary, through the Nellore district, right away to the coast, a distance of 400 miles; thus securing for the ryots, not only sufficient water for regular crops, but also facility of transport for their export-products at the lowest possible cost.

In all these large questions on which the equitable and thorough development of India's natural resources depend, the obstruction to be overcome is that of lack of funds and available capital. And to this end the first imperative consideration is the wise and productive use of the revenues of the country and its public credit. It is sometimes said in this case that funds are not available for this large and urgent object of inland navigation. Well, the practical question arises, have the surplus revenues and credit funds available for productive public works and conservation of India's natural resources, *e.g.*, its flood waters and rainfall, been or are now being utilised as wisely and largely for recuperative purposes as might have been? But this very large administrative survey cannot be more than thus touched upon here.

Weybridge, Feb. 19.

THIRTEENTH ORDINARY MEETING.

Wednesday, February 28th, 1906; Sir John Wolfe-Barry, K.C.B., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Laud, F. B. E., care of Commissioner of Customs, Kowloon, Hong Kong, China.

Muller, Godfrey Henry Emile, Government Electricity Works, Malta.

Pigot, Thomas F., 14, Fitzwilliam-place, Dublin.

Rogers, David Anderson, Balmaine, New South Wales, Australia.

Russell, Frank William, M.A., Dulwich College, S.E., and 4A, Moreton-terrace, Old Brompton-road, S.W.

Shimosé, Masachika, 110, Hakusan—Gotenmachi, Koishikawa, Tokyo, Japan.

Sutton, Gerald John, 50, Woodville-gardens, Ealing, W.

Tarachand, Shavak M., Burlington-house, Cumballa-hill, Bombay, India.

Tindall, Robert, J.P., Ashburn, Fordingbridge, Hants.

Walter, Rev. Frederick William, Burnham Overy Staithe, King's Lynn, Norfolk.

The following candidates were balloted for and duly elected members of the Society:—

De Pass, Eliot Arthur, 23, Queen's-gate-terrace, S.W.

Dinwoodie, John Frederick, Madras Railway, Perambur, Madras, India.

Ghose, A., F.C.S., Messrs. Jambon et Cie, Ramandrug, *viâ* Sandur, India.

Goodman, Alfred, Araucaria, East Molesey, Surrey.

O'Brien, Captain Aubrey John, C.I.E., care of Messrs. H. S. King and Co., 9, Pall Mall, S.W.

Rapelli, Luis, Ferro Carril Central Norte, Tucuman, Argentine Republic, South America.

Samy, Arthur Poonoo, 64, Queen's-road Central, Hong Kong, China.

Smith, R. Wilson, "The Chronicle" Office, Montreal, Canada.

Sparke Walter, care of Messrs. Thomas Cook and Son, Rangoon, Burma.

Wetton, Miss Edith, 54, Church-street, Kensington, W.

Young, Lawrence Charles Hills, 10, Hamam-street, Bombay, India.

The paper read was—

LONDON TRAFFIC.

By Captain G. S. C. Swinton, L.C.C.

London is suffering the penalty of over-popularity; how are we to cope with it?

To many a thinking man who cares, and dares, to look out into the future, who reads the prophecies of those who make a study of statistics and realises what a possible population of twelve millions on twenty miles square of land would mean, this mighty gathering of the people presages the most difficult problem of modern times. How can we expect to cope with it?

It is easy to be flippant, to talk of decentralisation, to suggest the scattering of the magnets of attraction, and making London less fashionable. The King's Court might remove permanently to Windsor. Parliament might travel the country, summoned, as in days of old, to meet one year at Lincoln, another at Winchester, another at York, perhaps at Edinburgh, Dublin, or even at Birmingham. The Law Courts could migrate to a more central position, say at Oxford; and the Bank of England and the Stock Exchange might combine to erect a garden city amid rural surroundings. All these outgoings, and we here could suggest many more, including most of the great businesses, would make for the emptying of London,—and for her starvation. Who would remain! It is so easy, unfortunately easy, for the poor to gravitate here; but it is easier still for the well-to-do to move out. That is the worst of those very facilities of travelling which we have met to-night to discuss; for *we* have to take London as we find her, and to make the best of her. We know that the great City has outgrown her system of communication, and is in imminent danger of being strangled by her own bulk.

One premiss we may lay down from the commencement. All London schemes must be on business principles. The interests are so vast, the dangers so great, the condition of a London from which bad management or philanthropic or sentimental extravagance had driven trade and capital is so unthinkable, that it is nothing short of a crime to put an unnecessary or unproductive penny on the rates. But it by no means follows that the largest and most imaginative schemes need be the most costly. We must march with the times and look ahead; above all we must beware of tying ourselves up with preconceived ideas and prejudices against what is new to us. When we consider London traffic we must pray—I say this with all deference to many of my hearers—that the artists and the architects will make common cause with the engineer. For the future is with him.

What we must strive for we can put under three headings. We want facilities

1st. For the trade and business on which London lives.

2nd. For the necessary movements of the persons who carry on that trade.

3rd. For the social movements of the people who reside in London and bring money into London because they find life there easier and pleasanter.

And we must be careful that this is the order, and that No. 2—the workers—are not considered before No. 1—the work. Of late so much has been said about the housing question that there has arisen a dangerous tendency to put the carriage of labour before the carriage of the fruits of labour. We must never forget that trade is the life-blood of the town. Incidentally I might mention that Mr. Gibson Bowles in his current election address, says that the trade of London is nearly one-third of the whole trade of the United Kingdom.

Our next point is, what do we mean by facilities? London is nowhere impassable; somehow or other we can kick our heels along

and eventually arrive anywhere. That is not what we want. We want to move fast, as fast as modern inventions enable us to move, twice as fast as we can at present. Such is the spirit of the age.

And so we regretfully put on one side the oldest thoroughfare of all, the waters of the Thames, historic, free and open, unhampered by cross traffic, never in need of costly repaving. If the Barrage scheme came to anything, if the 3,000 odd acres of river surface which traverses London from end to end, our greatest lung, almost comparable in size to all our parks and open spaces rolled into one, were converted from what it really is, a sheltered arm of the sea, into an inland lake, then it might be possible to use its waters for every day trading purposes, even to run a continuous passenger service which could compete in speed and price with the more up-to-date methods on land. But we are not likely to see a Barrage constructed, a tidal river gives us compensating advantages, and we are left to contend with the ebb and flow, the currents and the varying levels. The river has its uses, tremendous uses. It will carry, as it has for a thousand years, at small cost, everything, of all shapes and sizes, for which time is no object; and everybody who wishes to take the air on a fine summer's day. It even offers opportunities for philanthropic employers of labour who should care to house their workers in model villages outside, and carry them daily to and fro by express boats, non-stopping, and starting according to the tide. But as a serious contribution to really fast locomotion it is long since out of date, and the County Council steamboat service above the bridges was, I fear, obsolete before it was born.

Our river is our best trade asset, one which we share with many cities, but we have of late discovered another, peculiar to London. Who, even a generation ago, would have thought of the incalculable value to us of our stratum of blue clay, or could have imagined that, in 1906, we should be told that the Underground Electric Railways Company were completing arrangements for dealing with nearly 600,000,000 of passengers annually, over 100 miles of lines. Even to us, who are daily walking on the surface, it is staggering to hear of all that has been going on in the depths of the earth, almost unbeknown; to learn of the enterprise, the private enterprise, which has sunk 16,000,000 of sovereigns in order that we may move and move fast. There are people who do not like tubes, for whom they are too stuffy, who anticipate terrible accidents, and talk of the time when all the money they have cost will be wasted, when they will be given over to the growing of mushrooms or the harbouring of some new sect, much as the catacombs were used by the early Christians. I must note here that a Progressive friend has suggested to me that the sect would probably be the few remaining anti-municipal traders, a happy prophecy for those who hold steadfastly to the true faith. The tube despisers may be right, we would all of us prefer to live and to die above ground, we will fully admit that Parliament made an irreparable blunder when half a century ago it deliberately prevented the great railway companies from coming in to the centre, to some place like Seven-dials, where we saw last week three acres of land advertised for sale; but that is ancient history. There is no use crying over spilt milk, and for the moment the knowledge that we shall soon be able to start from Charing-cross and arrive at Hampstead or Highgate in 19 minutes, at Paddington in 15, at Euston or Baker-street in 10, and at the "Elephant and Castle" in 8, captivates the imagination. I am only mentioning a few of the routes. There are some points which will still require linking up, but we are to have fifty new stations and twenty-seven new miles of line, mostly underground. This is, indeed, a contribution to London traffic. The promoters (a damning name in some quarters) seem to be deserving well of their generation. Admittedly their system only purposes to deal with people, not with produce, but we may hope that some scheme for the carriage of a certain class of goods during the idler hours, and so aiming at a constant load factor for their electrical energy, will be evolved in the future. Once the scientific development of the infernal regions is taken seriously in hand, the uses of our belt of clay will not be confined to a few tubes. If we should still continue to burn anything so prehistoric as coal, there would be a certain poetic justice in its being bandied about underground. A coal-yard beneath Piccadilly-circus, whence motor coal-waggons could rise by lifts and shorten their journeys of distribution by many miles, would seem like reverting to natural laws.

But tubes and railways are food for discussion by the experts and the financiers, perhaps principally by the financiers. They are outside the province of most of us, and we hardly understand them. We accept them with

gratitude, we may or may not invest our savings in them, and we insure our lives against accidents. To-night, I wish to come nearer the surface, and to speak of what we all understand, the ordinary traffic of the streets. On that subject we all have ideas—good, bad, and indifferent, and we generally air them them freely. Now, what are the requirements of the ideal thoroughfare? A good surface—the wider the better—easy gradients, no obstruction, and therefore safety for all parties. It is a rare combination. The need of it drove fast traffic off the public roads three generations ago. To-day, with the advance of science, fast traffic is clamouring to come back, in many different forms. Can it do so with advantage? We can arrange the good surface and the easy gradients, but can it be both fast—what we would call fast—and safe? If not, can it be made so? What are the impediments?

One answer covers them all. In London, we are woefully wanting in space. This handicaps everything we wish to do. How can it be provided? We can steal it from some other use, such as a public garden or a park; we can purchase at great cost land and houses, sweep them away, and spread out on the level; or we can burrow, or go aloft. Remember that space is not necessarily on one plane. Burrowing deep enough, as with the tubes, we will get our way for nothing. If we want to be close to the surface, like the old "Underground" and the shallow tramways, we must buy cellars, take care of foundations, and beware of sewers. If we want to go overhead, we raise the question of "ancient lights," and the fear of noise and ugliness. It is not an easy matter, and it was the hopelessness of adequately dealing with it along the present streets which called for the scheme for the great avenues. They are proposed in the hope that they will be big enough and wide enough for all possible eventualities. I think I am correct in stating that Messrs. Meik and Beer were the first engineers to make a study of the traffic possibilities, on all levels, of these avenues, and to publish their views.

Foreign travel is always instructive, and we have some of us just returned from a visit to a neighbouring capital, where we have had borne in on us the advantages of space. The great Revolution, and the numerous minor troubles which have at times afflicted our old enemy, now our firm friend, may have been rather a heroic remedy for straightening out and widening roads, but in that direction they have had a glorious effect. We have only to motor through France to bless the Napoleonic dispositions for military concentration, and though it is curious to recall the fact that the wide boulevards of Paris had their origin not so much perhaps in the interests of locomotion as in a wholesome fear of barricades and the mob, we have only to traverse the town to regret that our Haussmanns had not the same chances. For do not let us run away with the idea that we in England have not from very early days had before us schemes every bit as fine. If Sir Christopher Wren had had his way we need not now be condemning our narrow streets, for he was keen to set a high standard, and many others, among them our Chairman's distinguished father, Sir Charles Barry, have over and over again endeavoured to make the people of London take a fitting view of their responsibilities. Most of these plans are well known; but I have before me an interesting, and I am told a rare, book, entitled "London and Westminster Improved. A Discourse on Publick Magnificence," by John Gwynn. It was published in 1766, and there is some reference to "the villages about London, such as Chelsea, Kensington, Knightsbridge, Paddington, and Islington," and a suggestion that they should be obliged to conform to some such sort of legal liability as we call a "Building Act." It is interesting to note that a few of Mr. Gwynn's plans have been adopted, but, alas, how few! How many chances have we let slip? Would that the following had ever been carried out. "As the New-road," the Euston and Marylebone-roads, "is proposed to be the great boundary for restraining the ruinous practice of building, on the north side of the town, so it is to be wished, that no building might be erected nearer than one hundred and twenty feet from the outermost line of it." That would have given us one of our great avenues, and is a lesson to us as to our treatment of the outskirts of the metropolis. If we now require an inspiration, to gird us up to effort, we may take the concluding paragraph of the introduction, written 140 years ago, in his best manner, by a great Englishman, who was a Londoner to the core, Dr. Johnson, "Let us, therefore, no longer neglect to enjoy our superiority; let us employ our riches in the encouragement of ingenious labour, by promoting the advancement of grandeur and elegance."

When we talk of the Paris boulevards, we all talk of Baron Haussmann. He was not the only improver of Paris, but he was so fortunate as to carry through his designs, and to live to see them complete and their success acknowledged. Let us take him as a type. How would he, if posted up in the latest scientific achievements, have attacked this London problem? Remember that he was a Parisian, and that our ideas of privacy and retirement, of the sanctity of green grass and country landscape, would not probably appeal to him. We understand that our neighbours like gaiety and glitter and colour. We are told that we ourselves take a somewhat khaki view of life. Let us imagine, if we can imagine such a thing, England as a French province, and Haussmann instructed to "treat" London, and with either of the Napoleons at his back. He would have taken a large map, not only of London, but of England, and he would have studied it carefully. And then he would have pointed out that the capital of the province was in the south-east corner of the land, that from the east, and from the south also to a great extent, the entrance to it was by the river and from the sea. He would have said—"You want your main land entrance for nine-tenths of your people and your produce (for he would not have ignored home produce) to be from the west and the north. Let us see if we cannot make a north-west avenue." And looking closer at the map of London he would have seen that not only was that the right direction for a road, but also that along a certain line it was the one most clear of obstruction in the way of buildings; that by some happy chance not only did the open country come far nearer into London along that line, but that, with the exception of a small stretch of not very expensive house property, it continued right through the heart of what we call the West End along a line of parks, almost down to the river, and then along the banks of the river to the City itself. He would not have minded cutting up the parks, and he would have treated them like the Champs Elysées. Either Napoleon would have supported him, and though Londoners would have been terribly scandalised, thus would have resulted a mighty traffic reform. Fancy a road, not 100 feet wide, but perhaps as much as 300 feet wide, having gathered together all the strings of communitions—north, south and west—outside, near Willesden, coming in across Wormwood Scrubbs. When it touched houses, it would make for the many gardens and squares surrounding Ladbroke-grove. These, Haussmann would have dealt with relentlessly; it is not impossible that in so doing he might have improved them. And then, a little to the east of Notting-hill-gate Station, the road would have again arrived at open space. Carried anglewise across Kensington-gardens, between the Round Pond and the Serpentine, and by way of Rotten-row, it would have divided the parallelogram of 640 acres into two somewhat similarly shaped triangles, and come out at Hyde-park Corner—a fine site for a triumphal arch to perpetuate, perhaps, the subjugation of the province—and then on by Constitution-hill and the Mall to Spring-gardens. For Haussmann, Drummond's Bank would have had no terrors. He would have increased the area of Trafalgar-square—incidentally altering its name—have doubled the width of Northumberland-avenue, and, by treating the Embankment-gardens and a strip off the Temple as part of his street scheme, he would have continued his victorious career to Blackfriars-bridge. There he would have made a great circus, and, I believe, stopped, or turned north. I do not think that even he could have hoped to carry a great avenue past the Bank and the Mansion House, though he would certainly never have countenanced the present width of Queen Victoria-street. Throughout the whole length he would not only have planted three avenues of trees, but, to make it up to date, he would have arranged, besides the main central avenue, subsidiary tracks for tramways and motor cars, as well as at least one fast and one express seldom stopping double track underground. If he had been properly advised by his railway experts, not only the tubes, but every company which had lines in the Willesden district would have been able to connect and forward electric cars along the route; while drainage, water, gas, hydraulic, electric power, telegraph and telephone mains would have had a free run. I said originally that this would have been a north-west avenue, and we naturally fall into the error of considering that anything that runs from the river to north of the park as going north-west, but on looking at the map we see that the real line is not far off east and west. We also see how straight it is. Along it we should reach open country from Blackfriars-bridge in five miles.

Such would have been Haussmann's avenue for the West. In the less important directions, taking Blackfriars as a convenient centre, he would have endeavoured to to go north, south,

and east on the same principles. Few of our main streets, with the exception of Mile-end-road, would have seemed wide enough to him, and he would have cut tracks, striving to take advantage of every garden, park, and open space which he could string into line. We should have said that he destroyed them. His answer would have been that he was not only saving money, but making the fullest use of them for the benefit of everybody; and he would have pointed out with considerable force that the majority of Londoners had never heard of half their parks, and if they had heard of them had not the remotest idea of how to reach them.

I must not be considered as advocating these methods, but when we are on the subject we should be foolish if we did not speculate as to how the problem would have been dealt with by the greatest master of street improvements.

So much for the grand manner of France. How, on the other hand, do we, a sober, conservative, profit-seeking nation try to get the same results? We naturally wish to keep all the advantages we have already, to destroy none of our amenities, to make a new route out of nothing and to make it pay. Therefore, the Royal Commission on London Traffic place on their programme two possible avenues, much I believe on the lines of those put forward in the first instance in this room by our Chairman, Sir John Wolfe-Barry. Probably most of you are thoroughly conversant with the proposals. The north and south avenue would run practically straight from the "Elephant and Castle" to Upper Holloway, crossing the river a couple of hundred yards to the west of Blackfriars-bridge, and keeping on the east side of Chancery-lane and King's-cross Station. The east and west scheme would join the terminus of the Mile-end-road with the Bayswater-road, running just south of Liverpool-street Station, the Foundling Hospital and Paddington Station. Its general direction would be parallel to the line of Oxford-street and of the Marylebone-road, which latter taps all the great northern termini. With all respect I rather feel that these two, under each of which there runs a railway, at present meet the case; that this line is through expensive property, where little profitable recoupment could be expected, and still far from the centre. There is no marked guiding line throughout, and the difficulty and cost of severance, of driving a devastating track which does not absolutely conform to the general trend of street formatioun, would be tremendous. Further north, not really so much further north, it would be possible to lead quite a cheap road through mean property, right athwart London. Of course, Oxford-street itself, or a bend to the south of it, is the true line. If permission could be obtained, it need not necessarily be considered wicked to take a slice off the whole length of Kensington-gardens and Hyde-park. From the Marble Arch a Haussmann would incline south, cut his way by Grosvenor-square and Golden-square, by the back of the Empire Theatre, along Long-acre and the north side of Lincoln's-inn-fields to Holborn-circus, and perhaps on by the Charterhouse to Liverpool-street and Mile-end. To go back to the other end, to Notting-hill-gate, there, as in the French scheme, the avenue would run out by Ladbroke-grove to Wormwood Scrubs. Such a road would really tap the heart of London and link up every artery, including those of the City. I would prefer not to make a guess as to what it would cost, but its advantages would be so enormous, its position so central, the recoupment which might reasonably be expected from its frontages so great, that I cannot but believe that if it ever comes to tackling the core of London it will be along that track.

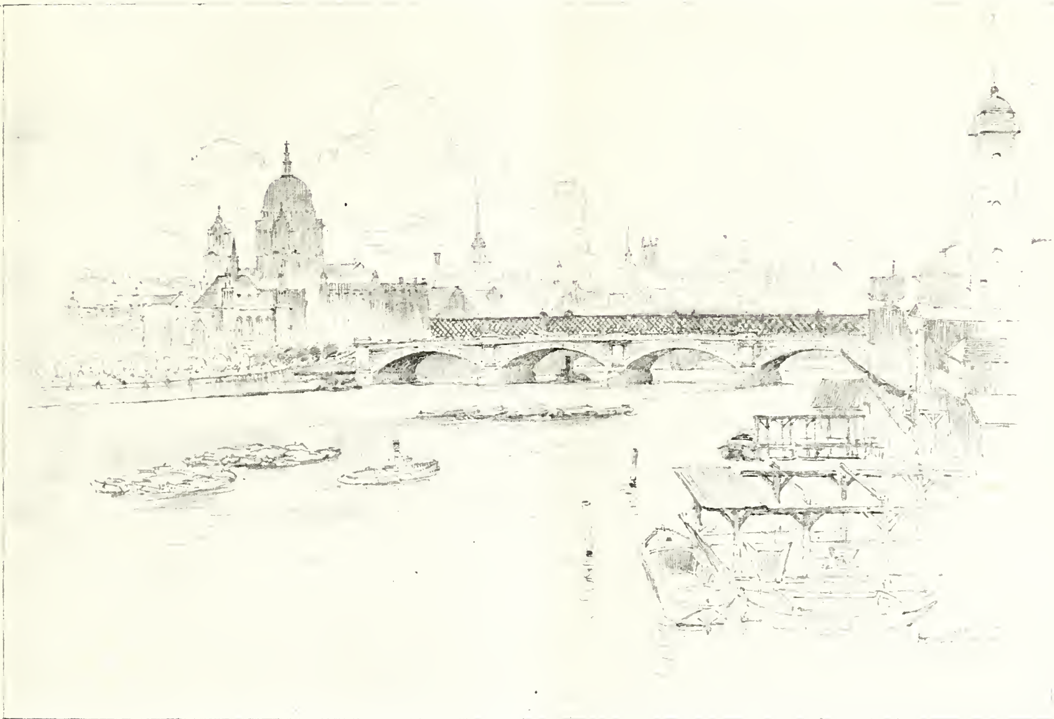
The great difficulty of proposals of this kind is that they take so long to mature, to bring in any return, financial or otherwise. Kingsway was commenced nearly seven years ago; its tramway was only opened on Saturday last, and its frontages are still unlet. How long would any of these schemes linger on! Remember that in carrying them out we should not only be playing the part of a destroying angel, paralysing the districts through which we passed—just imagine the building operations, the *débris* and the cartage, the difficulties at every crossing—but that up to the day that the destruction was completed and the whole road clear it would be impossible to make adequate use of the through express connection which is their chief object. Such a service could hardly be run in sections.

It is the devastation which makes me inclined to look further south, to a spot where we should gain two inestimable advantages, absolute severance, and the power of working out our own salvation without incommoding anybody. I refer to the line of the river. It is not so central, what we call central, though it runs though the middle of London and connects

with all the arteries, and it is not very straight. But if in coming in from the outside we should lose a little in mileage, we should easily make it up in increased speed. Where we should gain is that, like the tube builders down in the clay tunnelling unobtrusively like moles, the work would go quietly on, unknown to almost everybody, and loyal old Father Thames would bring the material and carry away the wreckage. If only he, or rather his Conservancy Board who manage his affairs, would submit to his having his width curtailed and his mud banks even further made use of. On them, as in our parks, we have our much-needed space. On the north bank, from Blackfriars-bridge to Battersea-bridge, four and a-half miles of broad road, unfortunately not half broad enough for what we want, were reclaimed from these mud banks at an expense of not much more than two millions, a very different matter from fifteen. Why not continue this to Putney? And on the south bank, that despised south bank, would not another wider embankment, developing as it gets eastwards into a commercial quay, rising to two or three storeys, with our fast road then climbing up from beneath the surface to the top, and leaving room for the barge and water communication on the tidal level, be a real trade improvement? This would be no question of severing property, it would destroy nothing, it would be following a natural line and putting an up-to-date business frontage, and so increased value on to the whole south side. I note that at Southwark-bridge and at London-bridge the river is far narrower, from bank to bank, than almost anywhere east of Hammersmith. This is so much an engineer's question that it is almost presumption for an amateur to press it, but if alone from the absence of severance and the water carriage of the materials of destruction and reconstruction, I feel that it ought to be put forward always in competition with the other proposals.

I have now got the length of going aloft, and when we turn to the Commissioners' North and South Avenue, surely, at one point, that is the reasonable solution of the problem. I do not think that here to-night we have time to deal with the whole road throughout its length, but, in the middle, London has a neck, from the "Elephant and Castle" to Farringdon-street Market. Between these points it is necessary to cross the Westminster-bridge and Borough-road at St. George's-circus, Stamford-street,—a main route of heavy trade haulage,—and then over Blackfriars-bridge, athwart the three main streams into the City by the Embankment, Fleet-street, and Holborn. Besides the main avenue which they propose parallel to this line, the engineers suggest a raised structure from the middle of Blackfriars-bridge to come to earth again short of Holborn-viaduct. Their desire is to get rid of the two bad blocks at the crossings. But the result would not only be ugly from its one-sidedness, but it would not be a complete scheme, for it would not add to the capacity of the bridge. If the engineers have satisfied themselves that the bridge would stand a second story over half its length, why not double its capacity by making that story extend right across; nay further, at least over the Stamford-street block. Such an addition need not by any means be an enormity. The beauty of the Thames and its bridges is part of our heritage, and we are all most anxious to carry the artistical experts with us. I have, therefore, had two sketches done by Mr. Penton, whose clever draughtsmanship many of us have long admired. One is the Blackfriars-bridge as it stands, not in itself a dream of beauty, and in no way improved by the hideous black line of the railway-bridge beyond it. The second shows how it would look if it were possible to give it a second story, much on the lines of many ancient aqueducts, perhaps not so artistic as the Ponte Vecchio, or old London-bridge, but still by no means ugly. You will note that the railway monstrosity behind is now masked, but that nothing of any advantage is lost, while the general character of the bridge is made somewhat more interesting. Unfortunately when Mr. Penton and I evolved this second storey out of our own imagination we had not before us two French bridges on the same lines. Both are over the Seine near Passy. One is iron, the second stone, and neither is a disgrace to beautiful Paris. Getting up on an elevated situation will always be the difficulty, but in this case both Blackfriars-road and Farringdon-street are wide enough and free enough from important side streets to make the ascent possible. Personally I have little doubt that once such an overhead road were seriously considered—the importance of traffic, and more especially tramway traffic, being enabled to pass freely across the busiest and most congested part of London, would be so patent that the elevated road would be extended southwards to clear both St. George's-circus and the heavy block at the "Elephant and Castle." Remember that it would double the carrying capacity of the road. As a set-off

FIG. 1.



BLACKFRIARS BRIDGE.

FIG. 2.

BLACKFRIARS BRIDGE—POSSIBLE SECOND STOREY.

against compensation to frontagers these might if they choose be connected with the upper track and so have a double-storied frontage. We always understood that it is the floor on the level with the traffic which has the value.

It was I think Mr. Basil Slade, the architect, who put forward the ingenious scheme for combining advantage and beauty by transplanting Charing-cross Station across the river and substituting for it a far-reaching improvment with the County-hall on a sort of *Isle de France*, who first called attention in the Press to double-storied bridges. He was then anxious to tone down the uncompromising ferocity of Hungerford-bridge by erecting a light steel structure on the top, which might have been extended to carry the tramways over the Strand and on north; but, though the South-Eastern Railway Company may one day themselves undertake this, they can hardly be expected to be anxious to give facilities for the L.C.C. tramways to compete with them.

I fear we can spare no more time to the greater schemes—the avenues. Let us turn our attention to the best thing of the kind which London has so far attempted—Kingsway and Aldwych. Before doing so I would like to interpolate that if from now on I deal exclusively with west-central London, it is as an illustration, because it is the part best known to most of us. Other districts have their problems as bad or even worse, but the great principles we are discussing obtain everywhere. I fear I must call Kingsway an unimaginative improvement, but we must remember that it had its origin before London traffic had become a serious study. With the view of giving an alternative route to the crowded alleys of Chancery-lane and Drury-lane, it was decided to join Holborn at Southampton-row with the Strand at Wellington-street. It apparently escaped notice that these were too highly-congested spots, that the proposal would tempt more traffic to them, and that there should be some method of dealing with the congestion. If it had been thought of soon enough, this might have taken the form of some "over and under" arrangement, or, as there were undoubted difficulties in that direction, circuses at either end might have been considered. Unfortunately these possibilities were thought of rather late. London must be wiser another time. Kingsway and Aldwych must endure their blocked ends, but I trust that in any future improvement of this kind, not only the linking up of the roads, but the linking up of the traffic across the roads, will be taken into account. When the trouble was put before the responsible people I fear that they thought of nothing but tramways. Even then they do not seem to have fully grasped what through traffic means. They proposed a subway, and everybody greeted with joy a scheme which seemed to give facilities for the northern trams to get south and the southern trams to get north. But what was the surprise of the uninitiated when they realised that the ordinary tramcars of neither system would be able to run through the tunnel, that it was not to be large enough, and that accordingly smaller single-decked cars were to be mingled with the big cars along the various routes. At what point the different types are to be marshalled and singled out, for such marshalling requires space, I do not know, but this arrangement would seem to be quite contrary to our ideas of fast through traffic, and to entail the very stopping and changing which the tunnel was intended to obviate. Under these circumstances would it not have been wiser to have had a much smaller and therefore cheaper tunnel in which would have run light cars which never left it, and which would have therefore required no costly approaches. Such a small tunnel might, with advantages, have been continued along Theobald's-road, which is narrow and often congested, at least as far as Gray's-inn-road. The present arrangements will be a serious disappointment to many.

To come up again to the surface, I should like to make a suggestion concerning what is known as the Crescent site. For the last two years, we have heard a great deal from men of taste as to the iniquity of allowing the eastern horn to jut forward, and so destroy the vista along the Strand. This, to the County Council, is a question of expense. We are anxious about our recoupment, and wish to sell every foot of land we can. Has it every struck anybody to inquire what is the need, were it not for that desire for uniformity which no one ever notices, except on a ground plan, of making the eastern arm of Aldwych of the same width as the western? The latter is bound to be a great trade route, leading from the north to the south across the river, and to the west. What vehicles are going to use the eastern arm, and where are they going to? A few cabs will be bound for the Law Courts and the Temple, and on into Fleet-street, but it will never be a route to the City, nor a through

route in any direction. It is a sort of backwater. I should be the last to suggest the narrowing of a street in being, but we have not yet let the ground, and it is not too late. I would suggest to the Strand Improvement Committee that, instead of again asking us to give up to open space, building land which, we are told, is worth £200,000, they should propose to us slightly to alter our ground plan. If we narrowed East Aldwych by five feet, we could afford to meet their views in setting back the Strand frontage, without losing a penny.

I have referred to the "over and under" method of dealing with cross traffic, and fortunately there is no longer any necessity to argue about the method being ideal. In teaching the lesson we have all of us learnt its difficulties. Mr. Fitzmaurice, the engineer of the London County Council, has laid it down that in his opinion an 18 feet headway, a 2 feet 6 inch superstructure, and a one in thirty gradient, are all essential. These figures on a dead-level road make the approaches 200 yards long at either end. In the older thoroughfares there are but few places where such space is possible. One of them, I believe, I was instrumental in bringing to notice, and the Royal Commission recommend it. I trust that some day Berkeley-street will be widened and carried under Piccadilly and down the side of the Green-park to the Mall, with a branch extending eastwards by Cleveland-row to Pall-mall. The fact that the ground slopes away from Piccadilly both north and south would make this easy to accomplish. It has been called an attack on the park, but, though personally I should be very loath to see the parks cut about, I cannot carry my views to the extent of putting green fields before necessities. The setting back of the frontage on the site of Walsingham-house, though it is only a very inadeqnate half measure and wofully extravagant at that, has undoubtedly done something to destroy the "neck of the bottle" argument against the widening of Piccadilly. It would not diminish the lung space nor harm the Green-park, nor, if care were taken, damage a single valuable tree, if a strip some ten yards wide was added to the roadway. And the advantages to traffic would be immense. Again, at the Marble arch, where just outside the gates there is a constant block and just inside a dreary expanse of macadam, it could in no way be said to detract from the beauty of the park if the gates were altered according to the plan suggested by a "citizen of London," Mr. Speaight. He proposes, and he backs his proposal with the offer of a munificent subscription towards the expenses, that the arch should be left standing where it is, but that the railings should be set back in a crescent form, so that the Park-lane traffic could cross towards Bayswater and Edgware roads, south of the arch, and *vice versâ*. Perhaps the flanks of his crescent would require some rearrangement, but there can be no doubt that it would result in a far finer entrance into the park and at the same time dissipate the congestion. It is interesting to hear that His Majesty's Office of Works are considering the suggestion, but the fact that while they are doing so, the County Council Improvements Committee, whose business it is, or should be, to watch all congested spots, have no official knowledge of the matter, points to a lack of system in the government of London. In this particular instance it is less important, but, at the other end of the Royal parks, where the enlarged Mall is going to make its exit into Trafalgar-square, the independent working of independent authorities will, I fear, ultimately result in a considerable waste of public money. It is, perhaps, a bold thing to criticise public departments, but I believe that anyone who is honoured by an invitation to state his views before the Society of Arts is expected to be bold, and I personally cannot but feel that a great opportunity has been missed at this point. It is well known that the County Council were most anxious to build their new house on the old ground, extending towards the Admiralty. We should have put up a fine building, facing the King's Palace, and worthy to close the end of the vista of the Memorial-way. It would have been possible to have led through its centre a royal road for state occasions, when the municipality of the capital would have opened its gates and given free passage. The ordinary road would have bifurcated on either side, to Cockspur-street and Whitehall, much to the advantage of traffic. Two things prevented us. We were too extravagant in our ideas of office room; the Board of Works, though I believe honestly anxious to accommodate us, were too extravagant in their terms. They wished, it was their right, full building value for every foot of the space. This made it impossible for the Council, and we have gone elsewhere. But what is the outcome? The Office of Works are going to put up a low building which, though architecturally beautiful when you got near it, will

be dominated all the way up the Memorial-road by the ragged hotel outlines behind it. They are not going themselves to build upon one-third of their valuable ground, and they will have to run their road out into the worst piece of cross traffic in London, a narrow sloping bottle-neck, where three streams of traffic converge. Not only this, but from the north and east their fine building will have no effect, unless, and this is the crux of the matter, the hugely expensive insurance and steamboat offices, which remain standing between them and the Nelson Monument, are swept out of existence. Who is to pay the piper? That the payment will be demanded, not only in the interests of appearance but in the interests of traffic, any man has only to go and stand by King Charles's statue and see for himself. It is the steep, narrow slope which makes the crossing so bad, and a tramway is promised. Into this turmoil it is proposed to shoot out, through a narrow entry, the accumulated traffic of the finest and fastest road through London. The opportunity of encouraging the County Council to expend the money which they are bound to expend somewhere in putting up a fine building, which would have done honour to the position and might have been so constructed as to solve all difficulties, is gone, but there have appeared in the Press vague statements referring to a possible naval musuem in honour of Nelson's year. If funds should be forthcoming to extend the wing of the Park gate-house due north to the frontage of the square, it would be a fitting site for anything of the kind, but, in the interests of safe locomotion, it is of paramount importance that the northern flank should be kept back, that the exit should be made treble its present width, and that the traffic should be led to the north. To revert to my original point. Could we have a better instance of the necessity of some body, qualified to supervise traffic, having at any rate a general knowledge of the schemes which different authorities have in their minds, and with the power of bringing them together, than this extravagant ending of the finest "improvement" that we have known in our generation? The probable result will be to add an unnecessary ten thousand square feet to the bottom of Trafalgar-square at, well—— we will call it a considerable price!

As regards the Memorial-way traffic, the greater portion of it will be bound for the Embankment and the City, and it may be of use to put on record an alternative route in view of the Trafalgar-square difficulties. If you look at the map you will see that the shortest line from the Duke of York's steps to Hungerford-bridge is not by Trafalgar-square, but along the south front of the Admiralty, through the little old house which is used by the Paymaster-General, across Whitehall, and thence by Whitehall-place, which has recently had its southern side very much set back, past the National Liberal Club. This route would entail the sacrifice of one house and some of the sanctity of the Horse Guards'-parade. It would give a better crossing-place, as there Whitehall is level and 120 feet wide. Though the openings would not be exactly opposite each other, the deviation would fortunately be to the left. I say "fortunately," and, as probably few people have ever worked out a street crossing on a plan, it may be well to explain. If two crowded streets intersect at right angles, without a circus, the flow of traffic must be entirely held up, by detachments. If the deviation is to the right the effect is the same, but if to the left a good driver will generally be able to make his way across by watching his opportunity. In that case it is well that not only the house frontage but the footway on the left side should be rounded off. I need not add that at all crossings it is of the utmost advantage that the house on the right hand side of the cross exits should have its corner cut off in order that the drivers should see each other as soon as possible.

At a dinner of the London Chamber of Commerce a week ago, one of the recognised authorities paid a high compliment to the police, and to their skill in managing traffic. It may only seem my imagination but it seems to me that, good as they always were, they have of late added to their high standard. They appear to take a larger view, to get a better control over the omnibuses and their stopping places, and generally to assist all classes of vehicles to move faster. But it was interesting to note in the Traffic Commission report that Mr. Henry deprecated "any increase of his powers to make regulations." He is anxious, and rightly anxious, that the "Bobby" should be everybody's friend, and that the police should only carry out regulations, and not take on themselves the responsibility and opprobrium of formulating them. Mr. Henry is probably wise in his views. The police are prepared to do their best to counteract the results of any crimes against traffic facilities which Londoners and London

bodies may perpetrate, such as bad alignments, wrongly placed shelters and lavatories, and that worst curse of all, the taking up of the roadway. But it is hard on them. They should be the first to be consulted in all cases, for they are the real experts, and the only organisers of traffic which we have up to date. They might with advantage instill some of their own intelligence and consideration for all interests into the minds of the drivers of slow and heavy vehicles. The rebuilding of London is just commencing, it will be with us for the next generation. Surely something might be arranged as regards the cartage of *débris* and new material. Like the repairs of the roadway this should be compulsory night work.

It would be easy to run on on countless topics, to brush up many good old schemes, to advance many excellent fresh ones. They are too numerous even to catalogue. One friend of mine wishes the Mall connected with the top of the Vauxhall-bridge-road, by a main street which would pass through the Duchy of Cornwall Office. He is quite correct, it would balance Constitution-hill and ease Victoria Station. To another the widening of Vigo-street is of superlative importance, more especially the short piece from Sackville-street. He points out that Regent-street should be brought down straight to Piccadilly. We all know that our chairman is anxious about Princes - street, Westminster. Others have designs on King William-street, on the western end of High Holborn, on Deanery-street and Bruton-street, Mayfair, on the York-road approach to Waterloo. The average Londoner is beginning to look at maps, and to realise facts quite new to him. He always thought that Westminster-bridge ran north and south. To his surprise he finds that it runs due east and west. He asks why Cromwell-road runs to a dead end, and why the road through Eaton-square, the finest road scheme in London, is hardly used at all. He says that the entrance to Liverpool-street Station is a scandal. The suggestions are endless; probably all useful. And do not let us run away with the idea that small improvements do not have great effects. The opening out of Green-street, Leicester-square, has tempted half the Strand 'buses to come that way from Piccadilly. Chandos-street requires widening to make the scheme complete. Even single houses are of value, and the difficulty of acquiring them often wrecks a street improvement. It is curious how the strongest vested interests, banking and the "trade," are to be found at all the corners where widening is wanted. One "public" juts out into Coventry-street, another occupies the corner of Great Queen-street and Drury-lane, blocking the end of Long-acre. The disappearance of Barclay's Bank from the south-east corner of the Haymarket, would enable that corner to be rounded off to the great advantage of all travellers. These are but three instances out of many more than three thousand with which the improvers of London would like to come to terms.

After all is said and done, when we have cut London about to our heart's content, what are the vehicles which are going to traverse our improved streets? On one point we have made up our minds. A revolution has taken place, and we have altered our standards of speed. The walking and trotting paces of a horse, four miles an hour and eight to twelve miles an hour, will suffice us no longer.

To turn our attention first to public conveyances, we see that the horse omnibus is going the way of the horse tramway. What is to take its place? Will the travelling public of the future elect to be carried smoothly along the middle of certain roads on a fixed line of rails, or will it prefer a slightly rougher but more mobile service which will take it in any direction and pick it up off the pavement at any point? Will the vehicles employed be dependent for their motive power on more definite street connection, or will they wander about the town relying each on its individual engine? At the moment it is impossible to say. It is, or it certainly should be, a question of which system gives the best all round value to the community, which system will move fastest, cause least obstruction, and be the cheapest. On the last point we have no figures. The motor omnibuses,—I think it well to mention that I am not financially interested in them to the extent of one penny,—are doing extraordinary well and earning large rewards, but it is early days for any certain estimate to be formed of their lasting and so of their paying capabilities. They are fast, and, when well driven, they minimise congestion. When in bad repair or badly driven they are noisy. The effect on the road surface, more especially of their great weight on pipes and connections beneath the surface, has been seriously questioned, but it is difficult to believe that the general tendency of their broad rubber-

shod wheels will not be to the advantage of all kinds of paving. We must remember thta they are still in their infancy, and capable of very considerable improvement.

What on the other hand is the future of the street tramway? It is indisputably the most comfortable mode of progression, excellent in wide uncongested streets, but in heavy traffic it is obstructive, and quite unable to do itself justice and show its natural turn of speed. Many will say that it has arrived at its zenith, and that no improvements or cheapening can be looked for. And when we talk of cheapening, and come to the question of cost, what do we in London pay for our system? At present no one knows; but a return dealing with the expenditure on street widening and other incidental expenses along tramway routes which the Finance Committee of the County Council will shortly present, will, I think, be a revelation. We are not here to discuss municipal trading, and we will put that burning topic on one side, and discuss London tramways on a business basis. Omnibus traffic, like all other traffic, gets along somehow. It can worm its way through narrow necks and take advantage of opportunities. It is essentially, what all traffic ought to be, fluid. A tramway route is uncompromising. It must have a minimum width. Opinions differ as to what such minimum width should be. Some say that 33 feet, 14 feet for a double track, and 9 feet 6 inches on either side for one line of vehicles is sufficient. I cannot believe that any traffic reformer will subscribe to this. It means that if a vehicle is standing, or moving slowly, on one side of the road, nothing can pass. Surely all here will agree that, if the interests of general traffic are to be considered, no tramway should be permitted along any main thoroughfare unless there is to be 18 feet clear on either side. If, to get this width, for tramway purposes—I must emphasise these words — costly widenings, and consequent repaving and other expenditure, are required, that is tramway business, and the expense should be charged against the tramway enterprise. It stands to reason that this is the only way of running the system on business principles, and so making comparison of the economic advantages to the people of London of the different methods of progression which are now offered to them. When we get the report of the Finance Committee we shall see what the tramway "right of way" has cost London up to now, and we shall be able to form some opinion of what it will cost to extend it through the far narrower streets and more expensive property north of the Thames. To this expenditure, if æsthetic considerations prevent us reverting to the over-head system, we shall have to add on the heavy charge for the conduit, a colossal item in the account. Then I trust we shall pause and think. The moment for quiet meditation will have arrived; with a rate bill in one hand and a cheque-book in the other.

I only want to say one word more about tramways. There is a rumour about that, because it takes time to collect fares on the roof, and to get people on and off the roof, the ordinary two-decker cars are to be done away with, and single deckers, with open trailers behind, substituted. In the name of common sense, I protest. Here are we widening streets at vast cost. All over London there is the cry of dear land, and buildings are going higher and deeper, adding attics and cellars. Is it the time for the tramways to be spread out on the level, for running trains through the streets, and at one stroke exactly doubling the obstruction?

While there are a great many who hold that it is permissible to subsidise a tramway system, there are a few who go even further, and would propose to kill the competing motor-bus by a special tax. This could never be justified on the grounds of equity, while it would have the disastrous effect of strangling the advance of scientific locomotion. But I must admit that a case could be made out for taxing the horses which are used in the centre of London with a view to pleasure and profit. And for this reason. London is an exceptional city which must be treated in an exceptional way. Do you realise what horses cost London by the beat of their iron-shod hoof, and the cleansing which their presence necessitates? In the City of Westminster there are 100 miles of streets, and the repaving, maintenance and cleansing, costs about £1,500 per mile annually. In Holborn there are 26 miles of streets which averaged £1,350 a mile. Probably much more than half of this expenditure is directly due to the horse. Perhaps they will disappear automatically, the cab-horse following the 'bus-horse, poor beasts, glad to go, but if they do not, I cannot think that it would be unfair to place some part of this expenditure on their backs, and, after due warning, to start a horse tax for London. Horses kept for trade purposes should be exempt. If such a tax came

into force in 1910, commencing at £1, rising to £2 in 1911, and so on up to £10, either the automatic disappearance of the unfit would be accelerated, or London would receive a considerable revenue to put against the cost of street maintenance. When half the gentlemen of England are going into training as mechanics the horse becomes a luxury for the rich. Fancy the advantage of no string of cabs, taking up, the four-wheelers 120 square feet, the hansoms 90 square feet, in streets like Piccadilly, where a square foot of land is worth £20. For with a proper motor-cab system the stands would all be underground, a single specimen, alone on the street level, being replaced by lift from below the moment he was called off his stand. But the advantages to inner London of the disappearance of half its horses cannot be done justice to at this hour of the evening. Taking all motors together, in the year ending 31st December, 1904, 5,023 were registered in London, including only four motor omnibuses. This of course being the first year included all then running. To that number there were added last year 4,074, including 236 motor omnibuses. What will be the figures ten months hence? The disappearance of the horse would have one effect, it would add half as much again to the general speed of the town. Whatever our methods, horses or no horses, that is what we must work for. Speed! Speed! How can we best attain it? The debt that we all owe to the Royal Commission and to their advising engineers no one can dispute. They have laid down the solid foundations upon which others will build in the years to come. But it is to the Traffic Board, which the Commission unanimously recommended, that we must look for the immediate and practical results. It is wanted to bring co-operation and co-ordination into our body politic, to overlook everything, to see that two capitals are not spent where one is sufficient, to look far afield across and outside of London, and far ahead into the wants of the future.

In the time at my disposal this evening, I fear that I have been unable to do more than scratch the surface of the subject, but I have endeavoured to put before you some of the views of one who has for five years traversed London in every direction, on foot and in every class of vehicle, who has stood long at street corners and at blocks, and who has always tried to keep his eyes on London traffic.

DISCUSSION.

The CHAIRMAN, in opening the discussion, after bearing his testimony to the interest with which he had heard the paper and to the ability with which it had been prepared, said he had taken a considerable interest in the subject of London traffic for a good many years. It was in the theatre of the Society of Arts that, in the years 1898 and 1899 he first ventured to direct the attention of Londoners to the subject of the streets and traffic of London, which, apparently, up to that time had not been dealt with, for very many years, at any rate, if at all. Perhaps to the interest then taken in the subject, coupled with the fact that the Post Office tore up the streets from end to end to lay their telephone wires soon afterwards, the appointment of the Royal Commission was due. Whatever people might think of the individual recommendations of the Royal Commission, the report had certainly brought into one focus an amount of information, study, and suggestion which had never yet been equalled in the history of England. He did not propose to follow Captain Swinton through the various matters to which he had directed attention, beyond saying that they seemed to be agreed in most of the essentials of the case, and that it must be left to the Traffic Board or to the authority which, no doubt, would be constituted to deal with the *pros* and *cons* of individual proposals. It was very useful, in considering the subject, to grasp for the moment what London really was, because people who had lived in London all their lives scarcely realised what was meant by Greater London. It was well known, from the Census Returns, that the population of Greater London, which was approximately the Police District, was at present $6\frac{1}{2}$ millions, and it was expected that within a very reasonable number of years it would be increased to 11 or 12 millions. London, starting from the centre, consisted first of the City of London. Outside the City of London was what had been well-termed the central area, which was a place surrounding the City of London with an area of about 24 square miles; the City itself being only one square mile. Outside the central area was what remained of the County of London, the area under the jurisdiction of the London County Council, which amounted to 92 square miles. Outside the County of London, and within the boundaries of greater London, was a further area of 576 square miles, which meant that the area of Greater London altogether was 693 square miles, or more than four times the size of the Isle of Wight. When the population of the various divisions was studied, very peculiar circumstances would be found. In the square mile of the City of London there was only 28,000 night population; in the central area around the City of London 1,200,000 night population; in the outer area of the County of London 3,150,000 night population; and in the outside area 2,000,000 night population. Studying the statistics further in detail,

it would be found that in the last decade the night population in the City of London had decreased by no less 28 per cent., the night population of the central area had decreased by 3 per cent., the night population of the remainder of the City of London had increased by 13 per cent., and the night population of the outer area had increased by the startling figure of 45 per cent. These figures showed a decreasing night population in the centre of London, and a most rapidly increasing population at the outskirts of Greater London. Those were the real questions which had to be dealt with in studying the traffic of London, because upwards of two millions of people came daily into the central area of London to earn their daily bread, or exercise their business, and departed again in the evening. The result was, that although the resident population was decreasing in the City and the Central portions, the throng of people was increasing more and more, and unless prudent people looked ahead, and provided for these circumstances, the trade of London, which was centred, and must always be centred, in the central area, would undoubtedly suffer and diminish in a most serious manner. It was not so much the circulation of people from place to place in London, which was the problem, but the enormous number of people always thronging in and out of the central area, which, roughly speaking, amounted to twenty-four square miles. There could not be much doubt that it was greatly for these reasons that the main avenues through the middle of London east and west and north and south were really necessary in order to provide means for people reaching the central parts of London, where all the warehouses and banking houses, dealing with the trade and commerce of the whole world were situated. That difficulty would get worse and worse as time went on, and therefore the central area should not be looked upon merely from the point of view of internal locomotion, but as absolutely requiring through lines of locomotion from east to west and from north to south. One must also recollect that the avenues were not merely for the purpose of street traffic, but were to be devoted to tramway traffic on the surface and electric railway traffic beneath the surface, connected at their extremity with radiating lines in all directions. If one thing stood out more clearly than another from the experience which had been gained by the great development of what Americans call "travel" in New York, it was that to provide for the present, and still more to provide for the future, the only way of dealing with a great metropolitan traffic was to have four lines of tramway or railway, so that the local stopping traffic could be accommodated and transferred to the express traffic at suitable distances. Now that the people had to travel long distances to get to their dwellings in the outskirts of London, that was the necessity which must be provided for in the future. Those things could not be done without wide streets and wide railways beneath the streets, and those appeared to him to be great arguments in favour of wide avenues bisecting London from north to south and east to west, apart from locomotion in the metropolis itself. Quick locomotion was the necessity of the present day if London was to compete with other cities. In the busy hours of the day the speed of travel in London, which was ordinarily very moderate, was reduced by one-half, the speed of a cab which could manage to do $6\frac{1}{2}$ or 7 miles an hour when the streets were nncrowded being reduced to $3\frac{1}{2}$ miles an hour in busy hours. Nobody would suggest that that state of affairs could be tolerated for ever, it was an impossible state of things in view of the great mechanical improvements which had taken place, and of the urgent necessity for getting about more quickly. Then everybody said, "Oh, yes, but look at the enormous cost." That point had not, he thought, been properly considered, but the fringe of the subject had been touched in one of the appendices of the Report of the Royal Commission. Mr. Charles Booth, who had studied London inhabitants more than any other person, had divided up the working classes into twenty-two different divisions, and gave the proportionate numbers and some idea of the average earnings of each class of the $2\frac{1}{8}$th millions people who went in and out of London every day for their work. If Mr. Booth's figures were applied, it would be found that those people earned every day £700,000, or, in a year of 250 working days, £173,000,000, which was the sort of figure affected by the want of locomotion. If those people lost only one per cent. of that figure, or £1,730,000, on that account, it justified a very heavy expenditure for indirect benefits. It, therefore, ought not to be looked upon as an extravagance to talk about spending about twenty or thirty millions in improving London, because it was a necessary expenditure, and the people who lived in London would get the benefit. If the amount of money at stake in London was considered, it seemed to him that the expenditure that had been mentioned, he would not say sank into insignificance, but appeared to be very much less than one would *a priori* realise. Sir John Pound (Chairman of the London General Omnibus Company) stated before the Royal Commission, that he estimated that two millions of money was lost to the omnibus passengers in one year through the laying of the Post-office telephones, reckoning the loss to each passenger at 1d. The loss on goods was also very serious, goods costing more to deliver on account of narrow streets, and, generally speaking, London as a city was undoubtedly suffering enormous loss by the want of good streets. If good streets were really available, the traffic of London would, he thought, settle itself. In connection with the subject of the proposed expenditure of 30 millions in dealing with the great subject of London locomotion, he wished to draw attention to the fact that the railways in the last twenty years had spent no less than 100 millions in trying to accommodate London traffic, which he presumed had been spent on good grounds and with a fair amount of prospect of return. In that case, although a direct benefit had been obtained, the indirect benefit of the expenditure could not be estimated—it was gigantic.

It seemed to him that the time had come when the subject deserved the most full consideration, and that if London was not to remain in a retrograde direction it was time—to use the expression of the Prince of Wales on a very famous occasion—for London to wake up.

Mr. ERNEST BENEDICT thought that unless tramways had been really wanted they would not have been constructed. Supposing there were no tramways, he would like to inquire how the traffic they at present carried, and which they had created, would be accommodated? If it was carried on vehicles not run on rails, would the people interested in those vehicles be called upon to pay for the widenings that were necessary to take the traffic? He could not understand why the very system which enabled millions to travel where thousands travelled before should be considered an enemy of the road, and be made to pay for a thing which nobody else had ever done. It was also said that trams were an obstruction, but they were not when moving, and there was nothing to prevent other vehicles following in their wake. With recognised stopping places, and a uniform speed of 16 miles an hour, an average speed of 12 miles an hour was obtained, including stoppages, which he did not think could be much improved upon. Trams were obstructive to slower vehicles, but not to faster traffic. With a stream of traffic going at a steady rate obstruction was reduced to a minimum. He thought a good deal too much was made of the question of the loss of time in the case of individuals, although it was no doubt serious in connection with goods. It did men good physically to walk about, and if walking was done away with their legs would become atrophied. If people valued every minute of their time at so much, why did they shave? They might save an enormous amount of time by growing beards, and put the money saved into street improvements! He suggested that, pending the formation of the Traffic Board, the whole of the London traffic should be placed under the control of a Police Commissioner or Traffic Manager, who should have district managers and inspectors under him. Such a man would in the course of time become an expert, and any suggestion he might make would carry great weight. He also suggested that the foot pavements should be raised a storey, as mentioned by the author, because, apart from the benefit to wheeled traffic, the foot passengers could then be carried across the streets above the ordinary traffic.

Mr. REGINALD MURE suggested that among the minor remedies which might be carried out for the improvement of London traffic a schedule should be made of the more important streets, in which, between fixed hours, certain rules should be observed. One cause of repeated obstruction in main thoroughfares was the use made by foot passengers of the carriage way. For instance, it was a common sight to see a small boy, with a packing-case on a truck, going leisurely along the road, oblivious of the fact that he was hindering a long line of traffic behind him. He therefore suggested that in certain scheduled streets foot passengers should not be allowed to use the roads except for the purpose of crossing, and also that no bicycles should be allowed in them, because they increased the difficulties of driving and were a source of danger to passengers crossing the roads. The crawling cab should be similarly treated. There were two things in favour of London traffic compared with the traffic of Continental cities, viz., that the drivers were certainly better, and that the police performed the functions entrusted to them in an admirable manner. The incessant breaking up of the streets was another source of trouble, and in his opinion the various companies which had statutory powers to open the roads should only be allowed to do so in a case of urgent necessity. The companies frequently opened the roads at the most busy time of the year, and often when they had just been paved with an expensive paving. After the roads had been made up again, in the course of three or four months they were in a state of disrepair, owing to the concrete under the surface of the paving being damaged, causing a sinking, and the whole road being practically ruined. He also desired to express regret that the London County Council were sinking so much money in providing supplies of electricity for either overhead or underground tramways, because he believed that it was not impossible to invent an auto-motor-car which would run without being supplied with electricity either from overhead or underground. If such a thing occurred, the whole of the money sunk in the conduit or overhead systems would be absolutely wasted; and there was no reason why it should not take place, considering the rapid improvements which were being introduced into motor-cars.

Mr. A. A. CAMPBELL SWINTON said he entirely disagreed with the last speaker's remarks, because the one advantage of electric tramways was that the motive power could be supplied from a single source, and applied in the cheapest possible way; in fact, it had been suggested that power should be supplied from a central station, by means of overhead wires, for the purpose of running omnibuses without the use of any rails at all. He also disagreed with Mr. Benedict's remark that tramways did not create an obstruction. They created an obstruction because they could not give way to the other traffic. If a cart was standing in the street delivering goods, and a tram-car came along, there was not enough room between the cart and the tram-car for another vehicle to pass, but a motor-car could edge off a little to the other side of the road and create the necessary room. In order to get the maximum amount of traffic along a road, the arrangements must be similar to a fluid passing through a pipe — the interstices must be as small as possible, but if one set of the traffic was run upon fixed rails, that was impossible, and the best results could not be ob-

tained. The tram rails themselves were also a very grave nuisance to other vehicles, and the damage inflicted on the wheels of vehicles which had to run over tram rails probably amounted to hundreds of thousands of pounds a year. In all probability, the wheels of vehicles which ran over roads on which tram rails were laid did not last half the time of those which ran on roads where there were no tram lines. He did not deny that tramways were a great benefit in some cases, but he was rapidly coming to the conclusion that the proper place for tramways was in the country. Tramways should be made along side roads, where the authorities could not afford to have a good road surface; but where the money could be afforded, a good road surface should be made, and automobiles run on it. The road surface should be made hard, and all the wear come on the wheels, which could be easily replaced, compared with the expense of making a road.

Mr. Maurice Fitzmaurice, C.M.G., said that one or two speakers had dealt very wisely with the good results which could be obtained from comparatively small improvements. For instance, facilities for traffic in London could be very nearly doubled by arrangements in the streets in regard to reinstatement of paving and slight alteration in the direction of the traffic. The provisions of the Bill brought in by the City of London two or three years ago, by which it was suggested that the surface of the street in any particular place should only be broken up at one particular time, and that notice should then be given to all those companies, &c., who had pipes or cables or anything of that kind under the surface to make their repairs at the same time, would enormously increase the facilities for traffic in London. At the present time a large number of authorities had power to take up the streets, and it was quite impossible for arrangements to be made whereby through lines of traffic were kept, some of the main streets being often broken up at different places at the same time. With a more central arrangement in regard to the details of the breaking up of the streets a good deal of annoyance in that way would be stopped. The author had referred to some of the improvements which had recently been made in London, such as Kingsway, the entrance of the Mall into Trafalgar-square, and the subway for trams underneath Kingsway. He was sorry Captain Swinton had taken such a dismal view of these improvements, which he (the speaker) hoped would not be so unsatisfactory as was anticipated. One could hardly expect, when Kingsway was only opened to traffic, and then not in a complete state, a few months ago, that all the sites for building could be let by the present time. There was a good deal to be said also with regard to the question of single-deck and double-deck cars. He was not in anyway responsible for the single-deck cars in the subway, because the whole matter was placed very fully before the Committee of the London County Council which dealt with the matter. There were, however, certain advantages in the single-deck cars. For instance, the loading and unloading were done very much more quickly than on double-deck cars, and the collection of fares was much more expeditiously performed. On many of the Council's double-deck cars at the present time it was necessary to have two collectors to take the fares. In double-deck cars, with quick acceleration, it was necessary to be careful when passengers were going up and down the steps that no accident happened, whereas on the single-deck cars the stoppages were much slower. He knew the tramcars both in the States and on the Continent pretty well, and believed the tramcars in New York carried per mile probably just as many passengers as the London cars. He admitted that there was a good deal of overcrowding in New York, but up to the present time no suggestion for introducing double-deck cars into that city had been made. He thought that, in a city where the houses were 22, 23, and 24 storeys high, if there was any advantage to be obtained from double-storey cars they would have been discovered by this time. Reference had been made to the cost of providing electric current for the London County Council's tramways. The cost of current for running a tramcar was a very small part of the actual running cost. A car took something like $1\frac{1}{2}$ units per car mile; and that if current could be obtained at $\frac{1}{2}$d. a unit, which he hoped would be the case from the Council's station, the cost was considerably under 1d. per car per mile, whereas the total running came to 6d. or 7d. per mile at the present time. The question of main roads was one to which he had given a good deal of thought; in fact, he placed before the Royal Commission different systems of dealing with roads of that kind. He was not at all sure in his own mind that main roads were quite what were wanted. For instance, in constructing a main road from anywhere between London Bridge and Waterloo Bridge towards the Crystal Palace, he did not think that road would be of much use to any of the people beyond half a mile from the road on either side. The fact of the matter was that such a road could be made cheaply in the outskirts, and that was the part where it was not wanted. Where it was wanted was where all the traffic gradually collected together, and that was where it was so expensive to make. No doubt further facilities were required, and one of the measures necessary in Central London was, in his opinion, another bridge over the Thames, between Blackfriars and Waterloo. He hoped the narrowing of the eastern arm of Aldwych, to which the autnor had referred, would not be attempted, because one of the plans which he placed before the Royal Commission, was a high level bridge over the Thames between Blackfriars and Waterloo. When it got to the north side of the Thames, the road went in two directions, one road sloping down to meet the eastern arm of Aldwych, so that it would then form a continuous road over the Thames by the new bridge from Waterloo Station; and the other arm branched off and went over the Strand on a

high level bridge, then continuing to Holborn, thus avoiding all the cross traffic in the Strand. It would in that way take all the traffic going to the south of the river from the north of Holborn and Holborn itself without bringing it into the Strand at all. He was glad to find the author had taken such a satisfactory view of roads through parks, a view he had held himself for a long time. Parks were no doubt a very great advantage from a health point of view; but he did not see that they would be damaged by having good roads made through them. He thought the very pessimistic wave which came over London about three years ago at the time of the appointment of the Royal Commission was not perhaps altogether justified, because a large number of tube railways were about to be opened which would carry an enormous amount of passengers. He never quite realised, until he read in *The Times* that morning that fifty-two new stations would be opened in London, in connection with these railways. The importance of the opening of these lines of travel could hardly be over-estimated, because they must, if they were to justify their existence, take an enormous number of passengers off the streets. A great deal of the improvement in London traffic must be carried out down below instead of in the streets, although, in common with other people, he much preferred the open-air routes. The Chairman had referred to the cost of the suggested large improvements, and the amount of money lost every year through blocks in the traffic; but he did not think any estimates of the loss of money in that direction could justify any very large increase in the rates of London at the present moment. The rates were quite high enough already, and if people thought the improvements were financially sound, money ought to be found to carry them out privately. A very large number of small improvements, in connection with the streets, could be made, such as the getting rid of too many refuges and lamps in the centre of the roadways, better directions in regard to the traffic, and better arrangements with regard to the continuity of the type of paving in different places. The Report of the Royal Commission mentioned a large number of schemes which had been put forward, and he found among them a number of tramways. He was not present either to advocate or defend tramways. Half the people of the country seemed to think that no tramways ought to exist, and the other half thought they were the very best means of locomotion. He noticed that the Advisory Board recommended tramways for such places as Queen Victoria-street and Cannon-street. The report of the Commision, however, resolved itself into saying that the recommendations were not to be considered as anything more than the merest outline of suggestions, and that a Board, or an authority which was continuous, and which would always keep its fingers on the pulse of the traffic of London, should be constituted. He desired to thank the Commission for the enormous amount of statistics they had prepared and the great labour they had given to the work, and thought that the suggestion for the creation of a Traffic Board or authority was the only way of dealing with the question.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to the author for his interesting paper, which Captain Swinton briefly acknowledged, and the meeting terminated.

THE COLOMBO HARBOUR WORKS.

On December 22nd water was, for the first time, allowed into the new graving dock at Colombo, making the virtual completion of the dock itself, a magnificent work worthy of comparison with any of its kind in the world. The north-west and north-east breakwaters are now having the last touches given to them, and before the next south-west monsoon it is expected they will be finished. The three breakwaters enclose an area fifty acres larger than the inside of the new harbour at Dover. The north-west breakwater is 2,670 feet in length, 32 feet in width, and the foundations of the blockwork extend to 30 feet below low water. It is founded throughout that level on a rubble base. The head of the work, and the jetty at the southern end, are nearing completion. The main or southern entrance to the harbour is 800 feet in width between the head of the south-west breakwater and the southern termination of the north-west breakwater. The top of the latter work consists of concrete deposited *en masse*. This concrete capping is about four feet thick on the top, and is uniformly at a level of 8 feet 6 inches above high-water mark. It is intended that, like the southern end, the northern end of this breakwater shall be finished with a parapet and a lighthouse. The northern entrance to the harbour is 700 feet in width. From this point to the shore, the harbour is protected by the north-east breakwater, consisting of a rubble mound formed by great masses of gneiss stone. As the teredo (marine worm) is very active in Colombo, the engineers thought it more economical to provide iron piling for the temporary staging used for depositing rubble in the north-east breakwater, and also in the crossing of the northern entrance to the harbour. Owing to the worm action, the life of timber piling is only five or six years. The fishery harbour, entering from Mateval Point towards the mouth of the Kelani, is for the sole use of fishermen, and a fine artificial beach of sand has been partially formed, and partially naturally deposited, on which boats and light craft can be conveniently beached, hauled up, and repaired. The harbour is protected by a mole of rubble slate about 800 feet in length, of which 750 feet have now been completed. The graving dock is 700 feet long, on the floor or bottom, 85 feet width of entrance, 32 feet over the sill, 113 feet top width, and 63 feet bottom width. The engines for pumping out are of the most modern type, and at the formal trials discharged 67,000 tons

of water in $3\frac{1}{2}$ hours. In addition special pumps are provided in duplicate for getting rid of rain water and such slight leakage through rock fissures as had to be provided for. The dock is expected to be open for use in July or August next, although the North Guide Pier, one of the contingent works associated with it, will not be completed till next year, nor will the full dredging and formation of the entrance channel.

Thirty years ago Colombo was an open roadstead; now, in the opinion of many experts, it is the most central and commanding port in the East, superior even to Singapore and Trincomalee, with reference to Western India, the Bay of Bengal and Burma, the Arabian Sea, East and South Africa, and Australia. But the great works now so near completion are only part of a vast scheme which sooner or later is likely to be carried out. According to the *Ceylon Observer*, to whom indebtedness is acknowledged for many of the particulars given above, there is a project for an enclosed wet dock, or inner harbour, in the direction of Maligakada, with easy communication to the main railway line. This dock would cover 115 acres, provide 13,200 lineal feet of key or wharfage, take in 25 of the largest ocean-going steamers in 30 feet of water, and have a jetty at the east end 1,500 feet long by 500 feet wide, with two parallel lines of sheds. It seems to be a fine conception with no engineering difficulties, and nothing to prevent its being carried out save cost. But that for the present bars it. It would cost at least three millions sterling, and the colony has too many claims upon it at present to bear this additional burden, for in addition to the works described above, a branch from outside the south-west breakwater, running for 2,000 feet to protect the main entrance, and to afford shelter to the harbour as a whole, as well as to the coaling jetties, is to be undertaken forthwith, and is estimated to cost £400,000. This arm will be 36 feet wide, against 34 feet for the south-west breakwater, and will be made with bigger beton blocks. It is not to be completed much before the end of 1909. The growth of the port of Colombo in recent years may be gathered from the following figures. The tonnage of British and foreign vessels engaged in the foreign trade which entered with cargoes and in ballast in 1888 was 1,811,439; in 1898 it had increased to 3,194,188; in 1902 it was 4,574,271; being exceeded only by London, Hong Kong, Liverpool, Singapore, and Cardiff.

MEXICAN WHEAT.

The United States Consul at Durango says it is safe to predict, that the production of wheat will increase steadily in Mexico for some years to come, perhaps more than any other crop. The increase in acreage planted, and in the quality and amount of wheat grown during the past few years, has been a marked feature in Mexican agriculture. Wheat advanced in price, together with other crops, with the building of railways, which brought also industrial enterprises, and in the cities and smaller towns of Mexico there has sprung up a middle class of artisans. With increase of wages comes an improvement of diet, seen for one thing in the relatively large consumption of meat. An even more conspicuous feature of the trend towards social improvement is the growth in popularity of white bread. At one time only the rich, or well-to-do (generally speaking, the landed proprietors and their families living in the towns) could afford wheaten bread, and "tortillas" (corn cakes) were used to a large extent in their dietary. Now the middle classes, and even the poorer people of the towns, whenever unusual work or any little good fortune brings them in a little money, will flock to the bakeries to buy white bread at prices altogether unreasonable, for flour is, though bad, exceedingly dear. American rolling mill machinery has been introduced, and the grade of flour is being improved slowly, as is the quality of the wheat crop grown. The demand exceeds the supply however, at least in certain districts of Mexico, and the pressure of good prices is driving all the ranch owners to plant more and more wheat each year. It is believed by some that wheat can be grown in Mexico without irrigation—all the wheat now grown on the arid plateau is winter wheat, and must be watered by artificial means. It has been suggested in various circles of late, that by deep ploughing shortly in advance of the rainy season, the land of this plateau would retain a very much larger proportion of the water that now so speedily soaks through it during the rainy months, and that spring wheat could be successfully grown within ninety days, if planted at the proper time. This would increase the size of the crop immediately, and also lead to improvements in methods of irrigation. A German agricultural expert who has been engaged of late by the Mexican Government for the purpose of introducing better kinds of fruit, is a great believer in this experiment with spring wheat on the plateau. He states that wheat can be planted successfully wherever there is a rainfall of 9·82 inches per year, if there is natural or other provision for the retaining of this water near the surface, and he puts the average rainfall of the northern part of Mexico at 13·8 inches a year. Another phase of the increased wheat cultivation, of interest to manufacturers, is the demand created for modern threshing machines, of which there was scarcely more than half a dozen in the whole State of Durango a few years ago. Ten or more threshing machines have been bought in one district alone in the past year, and the sale for others will, it may reasonably be expected, steadily and rapidly increase from the present time. The manufacturers who have been supplying the Mexican market have learned that it is necessary to make the machines with a "straw mangling" attachment, so as to leave the straw in the same shape as on the old Mexican threshing floors, for food for cattle.

HOME INDUSTRIES.

Consuls and Home Industries.—The resolution passed by the Council of the London Chamber of Commerce urging the Government, so soon as a Secretary of State for Commerce shall be appointed, to transfer the Consular Service in its commercial branches from the Foreign Office to the Department of Commerce is likely to accelerate a change that should be of much benefit to home industries. It is not easy to understand why the Consular Service was placed under the Foreign Minister. It is essentially a commercial service, and should be officered by men who have received a commercial training—qualified men trained in commerce. As it is, the majority of our consuls and vice-consuls are not only without commercial training, their appointment by, and association with, the Foreign Office encourages a disregard for, and even, as *The Times* puts it, a "disdain" of commerce, that sadly handicaps British merchants and manufacturers when competing with foreign rivals, backed as they are to the utmost possible extent by an alert Consular Service, for contracts abroad. The Government have approved in principle the suggested transference of the consuls, and it may be hoped that the new arrangements will make provision for more frequent reports from consuls stationed in the great commercial centres of the world, and indeed from all who have anything to report of interest and value to home industries.

London and Continental Ports.—Some figures bearing upon the comparative trade of London and the great continental ports may be of interest. The official statistics for 1905 are not yet available; those below refer to 1904:—

	Tonnage of Shipping.	Value, Imports, Exports	Depth of Channel.	Length of Quay.
London......	17,074,000	£269,000,000	24 ft.	44 miles
Hamburg......	9,613,000	£230,000,000	18 ft.	21 miles
Antwerp	7,990,000	£150,000,000	16 ft.	11 miles
Rotterdam ...	7,658,000	—	16 ft.	22 miles

The importance of the business transacted at a port is best gauged by the value of goods imported and exported, and the above figures show that London remains the premier port of the world. But the figures quoted do not give the full measure of the superiority. The value of the bulk of the imports and exports of Folkestone, Dover, Newhaven, Harwich, and Southampton, which come straight to or from London, should, as Sir George Ryder suggested to the Royal Commission on the Port of London, properly be added to the Port of London figures, and they amounted to £91,000,000 in 1904. On the other hand, the figures for Hamburg include coastwise, and for Antwerp river and canal traffic, representing in 1904 about £40,000,000. Rotterdam publishes no values, only quantities. Again, the figures relating to port accommodation are much more favourable to London than is generally supposed. Up to Tilbury Docks London has a *minimum* low-water channel of 24 feet, which in two years time will be 30 feet, and a high-water channel which in 1908 will be 49 feet. The Scheldt has at one point a *minimum* low-water depth of only 16 feet, and not more than 30 feet at ordinary high water. The low-water depths of the Elbe are rather better, but it is not safe to rely at high water on a greater depth than 30 feet. Nine miles below Rotterdam the depth of the Maas at low water is only 22 feet. Then as to dock accommodation, in London there are 28 miles of dock quays and about 16 miles of river wharves. In Hamburg there are only 21 miles, which include some quays not yet fully equipped. In Antwerp there are 11 miles of quays, in Rotterdam 22 miles, but half are only fit for canal traffic. At present, then, London compares favourably with its chief rivals whether the comparison touches tonnage entering the port, the value of imports and exports, the depth of the channel, or quay accommodation. Also the dock companies have ample surplus land, some 850 acres, to provide extensions for additional trade. Unfortunately the dock companies have spent virtually nothing on new works during the last six years owing to uncertainty as to Government intentions. All that has been done is to commence the deepening of the river, and to design and carry out contemplated dock works necessary to meet the additional accommodation that will be wanted before very long will take four or five years.

The Cotton Industry.—It is announced that four fresh cotton factories are to be erected, two at Bolton, and two at Oldham. The cost of these mills will be much heavier than it would have been a year ago, owing to the advance in the price of iron and steel, but notwithstanding this, and the number of new mills recently erected, and in the course of erection, further construction may be expected whilst the industry remains in its present flourishing condition. The exports of yarn and cloth in January show a large increase upon the figures of the corresponding month of last year; many contracts have been placed for delivery several months hence, and manufacturers of piece goods who usually produce for India, have work in hand that will last them for several months, some makers having orders that will carry them through the whole of the year. China has placed large orders to follow after current arrangements for delivery are completed; the Levant, Egypt, South America are sending an increasing volume of business for cloths of a miscellaneous character. The home trade, too, is healthy. So with fine spinning, just now a very remunerative business with excellent prospects. Employers in Bolton and South Lancashire who use long stapled cotton like Egyptian are said to be even more favourably situated than at the close of 1905. Altogether the outlook in the cotton industry continues to be very reassuring, and 1906 bids fair to rival 1905 in prosperity, if only the wages question gives rise to no complications.

Cotton Supplies.—Whilst the demand for the raw material continues to grow there is little fear that supplies will fall short this year. It is no longer doubtful that the American (1905-6) crop will be larger than was at one time thought likely. The stock of American in the middle of February at Liverpool was 1,062,000 bales against 869,000 last year, 549,000 in 1904, and 542,000 in 1903, and American planting preparations are on a scale that, given an average season, will meet all demands. Moreover, other growths are beginning to effect a greater influence. Up to the middle of February spinners had taken this year 33,000 bales more Brazilian than last year, 30,000 bales more Egyptian, and 6,000 bales more Peruvian and other descriptions. The Egyptian crop estimate may not be realised, but the East India crop has improved, and Bombay receipts are nearly 300,000 bales ahead of last year. The reports from the West Indies as to the growth of cotton are very encouraging. In nearly all the islands cotton is being grown in increasing quantities, and bids fair to be, before long, a considerable export, and in other parts of the Empire there is promise of considerable expansion in cotton cultivation, although it must be some years before the increase in supplies from these sources can do much to lessen the present dangerous dependence upon American shipments.

The Coal Output.—An advance proof of the tables relating to the output of coal and other minerals at mines worked under the Coal and Metalliferous Mines' Regulation Acts has just been issued, and gives the output of coal in 1905 as 236,111,150 tons as compared with 232,411,784 tons in 1904. The increase in the output was at the rate of 1·59 per cent. Speaking to a deputation that waited on him recently to urge the remission of the coal tax, the Chancellor of the Exchequer intimated that if the financial position had warranted it he should have been prepared to remove the tax; and it may be interesting to note the output since the imposition of the tax in the early part of the year 1901. In the opinion of coal owners, coal exporters, and ship owners examined by the Royal Commission on coal supplies, the tax was diminishing, and would diminish the export of coal, and consequently injure their trading power, and this view was supported by several of the British consuls resident on the Continent where the business in British coal is considerable. If regard is had to the total output only, the figures show that the rate of increase has not been maintained since the imposition as will be seen from the following percentages of increase or decrease in the ten years 1896-1905, the tax being in force since 1901:—

1896.	1900.	1901.	1903.	1905.
3%	+ 2·3%	+ 2·7%	− 1·4%	+ 1·59%

Moreover, although the volume of exports has increased it is contended that this increase is due to the increase in bunker coal, and in lower-priced coals which are exempt from the tax. It has to be remembered too that the freight on coal cargoes fell very considerably between the year 1900 and the year 1904. For example, the average freight from Cardiff to Genoa was 10s. 3d. in 1900, and 5s. 6d. in 1904. The freight from Goole to Rotterdam was 4s. 6d. in 1900, and as low as 2s. 9d. in 1904, while the freight from the Tyne to Hamburg fell from 5s. 2½d. in 1900 to 3s. 6d. in 1904. Although the figures do not conclusively prove it the Royal Commission were satisfied that an export duty must restrict the tonnage exported, and that the burden of the tax presses relatively more heavily on the coal which in value is slightly over the margin of price at which coal is exported free of duty.

The Jubilee of the Coal-Tar Colour Industry.—There was a meeting at the Mansion House on Monday to do honour to Dr. Perkin, the founder of the coal-tar colour industry. The platform was crowded with distinguished men of science, and about eighty persons were in the body of the room. The paucity of the general attendance gave point to the observations of several speakers—including Lord Rayleigh and Sir Henry Roscoe—as to what *The Times* calls the complete lack of understanding in this country on the commercial side of the complex requirements of the industry, and complete lack of sympathy between the capitalist and the scientific worker. Just fifty years ago a lad of eighteen oxidised aniline and obtained as product the colouring matter which afterwards became known as aniline purple or mauve. This discovery was of enormous importance, leading as it did to the discovery of many other colouring matters. Unfortunately it has not been Dr. Perkin's countrymen who have principally benefited by the industry which rests upon his discoveries. Professor Hofmann—then and for years afterwards in this country—with two other eminent German scientists, was willing and anxious to do for England what afterwards he did for Germany. But the British capitalist looked askance at experiments which could produce no immediate results in the way of dividends, and the industry went to Germany, where now it has perhaps the best claim to be called the national industry. The extent of it may be gathered from the fact that an arrangement has recently been made whereby five of the largest German firms engaged in the industry have become merged into two groups. These firms had command of a capital of nearly five millions sterling, and for several years past have paid dividends of from 20 to more than 30 per cent. per annum. In his speech at the Mansion House meeting, Lord Rayleigh said that it is not dearth of talent from which England is suffering, but the unreadiness of British manufacturers to give that encouragement and assistance to young scientists which they receive in Germany. No man of his generation has applied himself more devotedly to research work than Perkin, and few can point to greater practical results. Beloved by colleagues and

pupils, the maker of fortunes for others, but himself indifferent to pecuniary gain, the fiftieth anniversary of his epoch-making discovery will be fittingly commemorated by the presentation to Dr. Perkin, for his lifetime of an oil painting of himself, to become the property of the nation at his death; the execution of a marble bust, to be placed in the rooms of the Chemical Society; and the establishment of a "Perkin Research Fund" for the promotion of chemical research.

CORRESPONDENCE.

"CASH ON DELIVERY" AND SMALL SHOP-KEEPERS.

I should like to ask Mr. M. E. J. Gheury, who advocates this system in the number for Feb. 16, if he has any idea of the fraud and annoyance that are experienced where it is in operation. Parcels are sometimes sent not only to private residences but to hotels or apartments which have not been ordered nor are wanted, and servants and hotel porters pay for such parcels on delivery. What can the unfortunate recipient do but reimburse them the outlay? On one occasion I visited the town from which a parcel containing a manicure set had been sent to me, and on going to the address of the sender, I found a single room filled with a collection of the veriest trash that could be got together.

In fact, if cash on delivery (the C.O.D. of America) becomes general, it will open the door to a system of petty frauds and be another annoyance to householders and travellers, especially to any whose names appear in any seaside or other health resort newspapers. E. WEBSTER.

FIXATION OF NITROGEN.

Attention has been drawn to the necessity of providing a supply of nitrogen for growing wheat when the time shall have arrived in which the present known nitrogen beds are exhausted, and it is suggested that we shall have to rely upon the chemist to find a special supply to take its place.

A valuable article written by Sir William Ramsay for *The Times*, upon the fixation of nitrogen, gives a very full and accurate account of what has been done up to the present in obtaining a commercial form of nitrogen from the atmosphere.

Should the cost of its production from this source prove prohibitive there remain two alternatives; first, means might probably be found for obtaining nitrogen arising from the destruction of coal in a variety of power and heating systems, and secondly, there is one source which may in the distant future enter more largely into the economy of wheat production than any other, that is the cultivation of leguminous crops on the one hand, and the utilisation of a variety of oil seeds—cotton, rape, &c., which have been grown in suitable climates. Their residues, after the extraction of oil, might be used for the application of nitrogen to the soil, in combination with mineral manurial substances. It has been proved that meal derived from these seeds is a very valuable substance as a source of nitrogen. There are many sources of nitrogen in waste products, as well as the residues of animals consumed as food.

The natural production of wheat, without the aid of manures (and from all one can see it might go on for centuries), amounts to from eight to fourteen bushels per acre in climates that are suitable for its production, and this average may probably easily be maintained by a system of alternate crop and fallow.

The application of phosphoric acid potash without nitrogen produces a slightly increased crop. When the natural beds of nitrate of soda and potash are exhausted one need not be in any panic as to the food supply of the world, as a system of arable and stock farming, such as is still customary with many farmers in this country, could be adopted, mineral manures being used and the nitrogen obtained in a residual form from feeding animals on the root and other crops produced on the farm, with the addition of feeding cake and oil seeds, which are mostly grown without nitrogenous manure.

One can scarcely contemplate the date at which the population of the world may have so increased that its products cannot support the life of the people. Then, at any rate, the chemist will have a difficult problem to solve. E. PACKARD.

Ipswich, February 26th, 1906.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 7.—"Art in Painting and Photography." By J. C. DOLLMAN, A.R.W.S. DAVID MURRAY, R.A., will preside.

MARCH 14.—"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE. The RIGHT HON. ALFRED LYTTELTON, K.C., will preside.

MARCH 21.—"Motor Boats." By BERNARD B. REDWOOD, B.A. SIR JOHN I. THORNYCROFT, LL.D., F.R.S., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 15.—DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit., "The Languages of India and the Linguistic Survey." SIR CHARLES JAMES LYALL, K.C.S.I., C.I.E., LLD., will preside.

APRIL 26.—COLONEL SIR ARTHUR HENRY McMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

March 6.—"Imperial Questions in the West Indies." By Sir Nevile Lubbock, K.C.M.G. The Right Hon. Lord Strathcona, G.C.M.G., will preside.

May 1.—"Social Conditions in Australia." By the Hon. J. G. Jenkins, Agent-General for South Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock:—

March 20.—"English Royal Heraldry." By Cyril Davenport, F.S.A. William A. Lindsay, K.C., Windsor Herald, will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

Prof. Vivian B. Lewes, "Fire: Fire Risks and Fire Extinction." Four Lectures.

Lecture I.—March 12.—The Science of Fire—Ignition—Slow Combustion—Spontaneous Combustion—Results of Combustion—Flame—Smoke—The Oxides of Carbon, and Water Vapour—Causes of Fire and their classification.

Lecture II.—March 19—Fire Risks—Matches—Defective Flues and over-heated Stoves—Action of Heat on Wood—Pyrophoric Carbon—Lighting Dangers—Candles, Oil Lamps, Gas, and Electricity.

Lecture III.—March 26.—Storage Dangers—Spontaneous Ignition of Material in Bulk—Lamp-black—Charcoal—Coal—Fibre—Greasy Waste and Rags—Vapours—Dust and Dust Explosions—Nitro Compounds—Collodion Goods.

Lecture IV.—April 2.—Fire Prevention—The Fallacies Existing as to Fireproof Material—Stone and Iron *versus* Wood—Heat Conductivity—Fire-proofing Wood and Textile Fabrics—Fire Extinction—Sprinklers—Chemical Fire Extincteurs—Alarms.

Alfred Maskell, "Ivory." Three Lectures.

April 23, 30, May 7.

George W. Eve, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

MEETINGS FOR THE ENSUING WEEK.

Monday, March 5...Farmers' Club, 5, Whitehall-court, S.W., 4 p.m. Mr. A. E. Passingham, "The County Rate as it affects Agricultural Interests."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. R. G. Allanson - Winn, "Submerged Chain - Cable Groynes."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. W. D. Borland, "The Ignition of Nitro-compound Explosives in Small Arm Cartridges."

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. A. Yusuf Ali, "Civic Life in India."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. Andrew Craig Robinson, "The Bearing of Recent Oriental Discovery on Old Testament History." (Gunning Prize Essays.)

Asiatic, 22, Albemarle-street, W., 3 p.m.

Tuesday, March 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section) Sir Nevile Lubbock, "Imperial Questions in the West Indies."

Royal Institution, Albermarle-street, W., 5 p.m. Prof. W. Stirling, "Food and Nutrition." (Lecture V.)

Alpine Club, 23, Savile-row, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on papers (*a*) Mr. G. R. Jebb, "A Plea for better Country Roads." (*b*) Mr. J. E. Blackwall, "Country Roads for Modern Traffic." 2. Mr. J. J. Webster, "The Widnes and Runcorn Transporter-Bridge."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. E. J. Wall, Practical Demonstration. Prints in Natural Colours by the Pinatype Process and with Superimposed Carbon Tissues.

Zoological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. G. W. Bulman, "Garden Nomenclature."

Wednesday, March 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. J. C. Dollman, "Art in Painting and Photography."

Geological, Burlington-house, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. Ambrose P. Boyson, "Low Set Openings in Danish and other Scandinavian Churches."

Obstetrical, 20, Hanover-square, W., 8 p.m.

Thursday, March 8...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.

Royal Institution, Albermarle-street, W., 5 p.m. Mr. Francis Darwin, "The Physiology of Plants." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. V. A. Fynn, "A New Single-Phase Commutator Motor."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Friday, March 9...Royal Institution, Albemarle-street, W., 9 p.m. Dr. R. Hutchinson, "Some Dietetic Problems."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. R. Freeman, "The Design of a Two Hinged Spandrel-Braced Steel Arch."

Astronomical, Burlington-house, W., 5 p.m.

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Mr. A. Vye-Parminter, "French Modern Architecture."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

Saturday, March 10...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "The Corpuscular Theory of Matter." (Lecture II.)

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FRIDAY, MARCH 9, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 12, 8 p.m. (Cantor Lecture.) PROFESSOR VIVIAN B. LEWES, "Fire, Fire Risks, and Fire Extinction." (Lecture I.)

WEDNESDAY, MARCH 14, 8 p.m. (Ordinary Meeting.) GEOFFREY DRAGE, "Imperial Organisation from a Business Point of View."

THURSDAY, MARCH 15, 4.30 p.m. (Indian Section.) Dr. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Litt., "The Languages of India and the Linguistic Survey."

Further details of the Society's meetings will be found at the end of this number.

COLONIAL SECTION.

Tuesday afternoon, March 6; THE RIGHT HON. LORD STRATHCONA, G.C.M.G., in the chair.

The paper read was "Imperial Questions in the West Indies," by SIR NEVILE LUBBOCK, K.C.M.G.

The paper and report of the discussion will be published in a future number of the *Journal.*

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1906 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before Saturday the 1st April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of Inter-

national Exhibitions, the Department of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential services in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious labour."

In 1879, to Sir William Thomson (now Lord Kelvin), O.M., LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organic chemistry, and for his successful labour in promoting the cultivation of chemical education and research in England."

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S., "for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silkworms and domestic animals, whereby the arts of wine-making, silk production, and agriculture have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., "for the eminent services which, as a botanist and scientific traveller, and as Director of the National Botanical Department, he has rendered to the Arts, Manufactures, and Commerce by promoting an accurate knowledge of the floras and economic vegetable products of our several colonies and dependencies of the Empire."

In 1884, to Captain James Buchanan Eads, "the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

In 1885, to Mr. (afterwards Sir) Henry Doulton, "in recognition of the impulse given by him to the production of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (afterwards Lord Masham), "for the services he has rendered to the textile industries, especially by the substitution of mechanical wool combing for hand combing, and by the introduction and development of a new industry—the utilisation of waste silk."

In 1887, to Her Majesty Queen Victoria, "in commemoration of the progress of Arts, Manufactures, and Commerce throughout the Empire during the fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S., "in recognition of the value of his researches in various branches of science and of their practical results upon music, painting, and the useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for his achievements in promoting the Arts, Manufactures, and Commerce, through the world-wide influence which his researches and writings have had upon the progress of the science and practice of metallurgy."

In 1890, to William Henry Perkin, F.R.S., "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilisation of large quantities of a previously worthless material."

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S., "in recognition of the manner in which he has promoted several important classes of the Arts and Manufactures, by the applicatiou of Chemical Science, and especially by his researches in the manufacture of iron and of steel; and also in acknowledgment of the great services he has rendered to the State in the provision of

improved war material, and as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognition of the merits of his numerous and valuable inventions, especially his improvements in telegraphy, in telephony, and in electric lighting, and for his discovery of a means of reproducing vocal sounds by the phonograph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S., "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted."

In 1894, to Sir Joseph (now Lord) Lister, F.R.S., "for the discovery and establishment of the antiseptic method of treating wounds and injuries by which not only has the art of surgery being generally promoted, and human life saved in all parts of the world, but extensive industries have been created for the supply of materials required for carrying the treatment into effect."

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his metallurgical researches and the resulting development of the iron and steel industries."

In 1896, to Prof. David Edward Hughes, F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

In 1897, to George James Symons, F.R.S., "for the services he has rendered to the United Kingdom by affording to engineers engaged in the water supply and the sewage of towns a trustworthy basis for their work, by establishing and carrying on during nearly forty years systematic observations (now at over 3,000 stations) of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself."

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S., "in recognition of his numerous and most valuable applications of Chemistry and Physics to the Arts and to Manufactures."

In 1899, to Sir William Crookes, F.R.S., "for his extensive and laborious researches in chemistry and in physics; researches which have, in many instances, developed into useful practical applications in the Arts and Manufactures."

In 1900, to Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small, a discovery now used in all dynamo machines; and for its application to the production of the electric search-light, and to the electro-deposition of metals from their solutions."

In 1901, to HIS MAJESTY THE KING, "in recognition of the aid rendered by His Majesty to Arts, Manufactures, and Commerce during thirty-eight years' Presidency of the Society of Arts, by undertaking the direction of important exhibitions in this country and the executive control of British representation at International Exhibitions abroad, and also by many other services to the cause of British Industry."

In 1902, to Professor Alexander Graham Bell, "for his invention of the Telephone."

In 1903, to Sir Charles Augustus Hartley, K.C.M.G., "in recognition of his services, extending over 44 years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over 20 years, as British Commissioner on the International Technical Commission of the Suez Canal."

In 1904, to Walter Crane, "in recognition of the services he has rendered to Art and Industry by awakening popular interest in Decorative Art and Craftsmanship, and by promoting the recognition of English Art in the form most material to the commercial prosperity of the country."

In 1905, to Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S., "in recognition of the influence which his researches directed to the increase of scientific applications, the production of improved lenses, and the development of apparatus for Sound Signalling at Sea."

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday evening, February 20th; The HON. JOHN FORTESCUE, King's Librarian at Windsor Castle, in the chair.

The paper read was—

ON SOME ILLUMINATED MANUSCRIPTS OF CONTINENTAL EUROPE.

By H. YATES THOMPSON, F.S.A.

I printed, some years ago, a lecture delivered by me at Cambridge, as Sandars Reader to the University, "On English Illuminated Manuscripts," based upon some volumes in my own library. I will now endeavour to treat similarly a selection from the same source, of specimens of the art of miniature painting in continental Europe, from the eleventh to the fifteenth century. My object is not so much to instruct, as to exhibit. If it were conceivable that I could receive each and every one of my present audience in my library, and endeavour to inflame their curiosity in

regard to the history of miniature painting in Europe, there are certain books that I should take down, and turn over. I hope to treat my present audience in a similar manner, only that, instead of taking down the books themselves, I shall show on the lantern screen specimen pages from those books, in the hope that even so meagre a sketch may arouse curiosity, and a desire to pursue the subject farther. In this connection, I should mention that Dr. Warner, the eminent head of the MS. Department at the British Museum, has recently rearranged the exhibited MSS. in such a way that the passer-by may see a series of fine specimens in sequence of countries, beginning with the Byzantine MSS. on the left, as you enter, and passing on by English, French, Flemish, and Italian, till, at the end of the room, you have seen something considerable in illustration of all the great European schools of miniature painting.

Like Dr. Warner, I propose to begin with a Byzantine MS., written and painted at Constantinople in the eleventh century, when Byzantine art reached its highest perfection. I will next show you, by a few specimens, how, in the twelfth century, not without Byzantine influence, new schools of painting rose in Italy, Germany, and France. After that, we will concentrate our attention on France, the real centre and home of the art during the thirteenth, fourteenth, and fifteenth centuries, and I will show you how, in that delightful country, successive kings and queens, warriors and bishops, abbesses and princesses, however much they fought among themselves on other questions, all united in one common belief, namely, that no pains was too great, no sum of money too vast, to expend on the acquisition of first-rate books of illuminated manuscripts.

Let us then open the first page of the heavy quarto volume which, written in the eleventh century, the time of our Conqueror, Duke William of Normandy, after having for many generations been the book from which the lessons were read by some Greek priest, in a Constantinople church, found its way into the library of the Duke of Hamilton, and thence, by purchase of the German Museum, to Berlin, in 1882. Happily, the German Government was seized with a fit of economy, and, under the influence of Prince Bismarck, who had no soul for illuminated MSS., and thought they had spent too much money on the Hamilton-palace books, they dumped this invaluable volume and several others on the London market, with the result that it now has taken its place among my hundred best MSS.

All the pictures I have shown you from this Greek MS. display what I call the Persian carpet style of decoration, abounding in cobalt blue, I suppose because lapis-lazuli from which it was produced was common and cheaper in Eastern than in Western Europe. Witness my next slide taken from a real Persian MS. in my collection, of the year 1410, and written at Shiraz or Ispahan. Did the Persian artist derive from Constantinople? Or did both Byzantine and Persian derive from some still earlier development of Asiatic art? I think it is not unsafe to conclude that the Byzantine figure drawing was of classical origin, while the ornamental frames by which the pictures were surrounded were in the main inspired from the East. From whatever sources their style was derived, there is no doubt but that Byzantine art exercised a strong influence over the rising schools of Germany, Italy and France.

Remembering that the Greek gospel-book which you have just examined was of the eleventh century, and that Byzantine art had been in a state of continuous, though often interrupted, development, during the preceding five or six centuries, and that some, at all events, of their books and other artistic productions had strayed over into the semi-barbarous countries of Western Europe, let us see what Germany, Italy and France were doing in the period immediately following. Deep in the forest wilds of Bavaria is the ancient monastery of Ottenbeuern. Here, in the twelfth century, the monk, Rheinfried, wrote for his Abbot, or perhaps for his patron, Alexander, a "Collectarius," or collection of prayers, and thoughtfully put in for our benefit a portrait of himself, holding the book in his hand.

But while Rheinfried was working away in his rude manner at the Collectarius for the monastery of Ottenbeuern, what was going on at a more famous monastery in South Italy, that of Monte Cassino? Here the pains and industrious art of the Benedictines raised up a school of book decoration which, beginning in the days of Justinian, reached its climax of artistic excellence about this time. For its figures this Monte Cassino school owed everything to Constantinople, but its ornamental work is a new development. Unfortunately I cannot show you any of their figure drawing. Out of Italy, indeed out of the Monte Cassino

library, these books are so rare that I believe my volume is almost the only specimen in England, and from it the figure picture, probably of the Crucifixion, has been, sad to say, extracted by some inconsiderate person.

We now reach the rich distinctive period of French miniature painting. Nearly two hundred years have passed away, years of steady development, and we now come to the great Antiphonary of the convent of Beau Pré, six giant volumes, which for near three hundred years lay, three on either side of the chancel, in the convent of the nunnery, the alternate verses of psalm and anthem rising in turn to the groined roof, and subsequently doubtless to the Heaven above. These books, six in number, came somehow to London, about thirty years ago. Three of them were sold at Sotheby's, and the ultimate buyer was Professor Ruskin. From his estate they have lately passed into my library. Mr. Ruskin asked where the other three were; he was told they had been burnt in a recent fire. The three that remained, our three, were among the greatest treasures of Brantwood. But Mr. Ruskin with all his skill and enthusiasm never discovered where the convent of Beau Pré was. And this was no wonder, for there were scores of convents of the name of Beau Pré. I will now explain the chain of evidence by which the book has revealed its origin.

I should premise that this Antiphonary is unique among books of the sort, in that the first page, in a contemporary hand, tells us (1) the name of the convent, "De Bello Prato" or Beau Pré, and (2) the date of the book, 1290. The whole inscription is pleasing:—

"Liber ecclesie beate Marie de bello prato.
Qui scriptus fuit anno ab incarnatione domini
millesimo ducentissimo nonogesimo
si quis illum abstulerit anathema sit.
Si quis illum fideliter et honeste tractaverit et
servaverit benedictus sit. Amen."

Let us hope the present and all future owners may merit the blessing and not the curse.

But this does not carry us in the history of the book beyond the certainty of the date and the name of Beau Pré. The next page gives the opening of the service, and in the margin are two little figures with names inscribed, "Domicella de Viana" and "Clementia." And this is the page that reveals the secret. Who was the Domicella de Viana? and who was Clementia? We set to work to discover among all the Beau Pré convents one which should be connected with a place named Viana. What was my delight when I found in an old map of East Flanders, not far from Ghent, and two or three miles from Gherartsberg, or Grammont, a convent of Beau Pré, and about five miles from it a village and chateau of Vianen. I at once wrote to Father Van den Gheyn, the excellent chief of the MS. Department in the Royal Library at Brussels, to ask him if he knew anything of the convent of Beau Pré, and of the lady of Vianen. In reply, I learned that this convent of Beau Pré, of the Order of St. Bernard, was founded in 1228, and was occupied by Cistercian nuns till 1795, when the French Republic came down upon them, drove out the nuns, and sold the convent and its lands by public auction. The "Domicella de Viana" was a certain Marie de Bornaing, wife of the Seigneur of Vianen, a little country town near Beau Pré, whose family is recorded as having been benefactors of the convent on many occasions, especially making frequent presents of firewood, and there is no moral doubt but that this Marie is the lady who gave them this splendid Antiphonary, as the text says, "Pour Dieu et en aumosne à l'Abbaye." Marie de Bornaing, or de Viana, had also a niece, named Clementia. What is further most remarkable about the books is that they are illuminated in the highest style of the art of the period, probably in one of neighbouring towns—Courtrai, Arras, or Douai. I have inquired in Brussels, Paris, and the British Museum, and I can find no French Antiphonary of this great size, of any period, so finely illuminated.

So delighted was I by these discoveries, that I made an expedition to Grammont, this country town of East Flanders, about two hours railway journey from Brussels, and drove out to Beau Pré, two or three miles, to see for myself the first home of my Antiphonary. An old white Flemish mare took us, in a rural brougham, along a causeway, with green fields and poplars on either side, and deposited us safely at the convent gate. For, strange to say, in the whirligig of time, the convent, after being owned by Cistercian nuns for 550 years, and by a private family for 109 years, became last year a convent again. A party of some thirty Soeurs de Nazareth, from Montmirail in France, early last year, being turned out of their French home by the legislation of the present French Republic, had taken refuge in Beau Pré, having bought the house and grounds a few months before our visit. The Lady Superior was charmed to hear something of her holy predecessors and

their Antiphonary, and showed us most kindly all there was to see. We found no vestige left of the old thirteenth century nunnery, except some wells and half a tombstone, engraved with the effigy of half an abbess. The original building had all been destroyed by fire in the seventeenth century, and now, but for the well heads and the fragment of the abbess's tomb, the only remnant of the old foundation of 1228 is the Antiphonary which we are discussing.

Finally, we have a portrait of the monk, Johannes, who wrote some portion, at all events, of the Antiphonary. It is not at all improbable that this Johannes was identical with a certain Johannes of Cambron, the mother house of the Beau Pré convent, and situated only sixteen miles away, for we find his name and address as the writer of a volume now at the British Museum ; but this requires verification. If it be so, we have in this Antiphonary a most unusual and delightful series of particulars and portraits, including the date of 1290, the name and likeness of the donor and her niece, those of the abbess and her nuns, and finally of the scribe who wrote, at all events, the third volume. I wish we had also that of the artist, especially of the comic painter who adorned many of the pages with little caricatures, most of which have unfortunately been expunged by some careful abbess who objected, I suppose, to any comic element being introduced in the serious Antiphonary. I give a specimen of one of these little scenes, that of a fish-stall in some French-Flemish town, spared possibly because the fish was a holy creature, the emblem of our Saviour, and the subject and means of many miracles, from the days of Tobias, Jonah and St. Peter, down to the time when St. Francis of Assisi, and St. Anthony of Padua, preached to the fishes. Anyhow, we have before us as realistic a scene of market life in the year 1290 as is to be found anywhere, and this is not surprising, for French Flanders, of all the countries of Western Europe, was perhaps the head-quarters of the grotesque in miniature. The subject is so important that I shall show you a few examples of the art as seen in the adornment of another of my books, the "Verdun Breviary," a book produced probably not far from Metz, for Marguerite de Bar, the Abbess of Verdun. The family of De Bar, a famous European ducal family in its day, connected with most of the royal houses, had for its arms two fish (the maigre or bar of the menus of the modern table d'hôte), and almost every capital in the Breviary has emblazoned within it either the arms of the lady's own family or those of England, France, Navarre, Evreux, or some one of the great houses with which the noble Abbess was connected. But the little scenes of Bible history, daily life, or comic caricature, of which I shall now show some specimens, are the great distinction of the book.

We have seen something of the serious and comic art of the thirteenth century. Let us now dip for a moment into the fourteenth century, and turn over a few pages of a Prayer-book which was prepared for a Queen, whom I have not yet been able to identify. Here she is depicted on the first page, coifed and crowned, with her book of hours lying on a stool before her, while her chaplain elevates the host. This is the serious side of her religion. But the services were long, and the Latin prayers tedious, and for her amusement she had little hunting scenes depicted at the bottom of many pages. The lady was evidently fond of field sports, between twenty and thirty pages being devoted to her exploits in pursuit of rabbits, ducks, stags, and wild boar. Not only did this anonymous Queen delight in the sports of the field, she was also fond of little stories, of a more or less moral nature, in which figured knights and ladies, monsters and monks, princesses and magicians. One of these stories, quite a moral one, is illustrated by five pictures, and a little legend in red ink explains each of the five. Though the solemn prayers above are in Latin, the legend below is in intelligible French. The story tells of the adventures of Theophilus. This was a French legend of Eastern origin, and there were several versions of it. It is told in glass in the cathedral of Beauvais, and in stone at Paris in the tympanum of one of the doors of Notre Dame.

We have glanced at two grand periods of miniature painting, that of the Byzantine predominance in the eleventh and twelfth century, and that of its early French development in the thirteenth century, with some of its characteristic serious and comic phases. I will now carry you on to the fifteenth century, when perspective began to be thoroughly understood, and the art of book illumination in France reached its highest point of artistic excellence. It is singular, when all is considered it is almost miraculous, that through all the wars of France, the Crusades and the civil commotions that raged throughout these stormy centuries, the deli-

cious art of miniature painting went on undisturbed, sometimes in the quiet convents, sometimes in the studios of lay artists in Paris, Cambrai, Metz, Rouen, and other towns of the provinces. Never was there a more troublous time than the first half of the fifteenth century. The Black Prince had sorely tormented them in the fourteenth century. But with the fifteenth came the still more terrible Henry V., the bloody conquest of France by the English, and the still more dreadful episode of the liberation of the territory, initiated by the Maid of Orleans, and finally effected by a group of French warriors, of whom naturally much less is said in our patriotic English histories. It is a strange circumstance that throughout the Hundred Years' War the Generals and Admirals on both sides had the time and taste to acquire the most lovely books. The Dukes of Bedford and Gloucester, the Admiral Coëtivy and the Bastard of Orleans, and what is still more surprising, the Earl of Shrewsbury, the renowned John Talbot, had exquisite "Books of Hours," for which their affection was so great that they frequently carried them about with them to their sieges and pitched battles. I have four such in my library, and will show you pages from two or three of them.

Perhaps the most renowned of the commanders of the time was Jean Dunois, the Bastard of Orleans, not a bookish-man, as his statue still preserved in his castle of Chateaudun shows him to us.

The little volume contains three portraits of the hero. In one he is praying to the Virgin, and it is from this contemporary picture that the well known portrait by Montfaucon has been taken. I wonder sometimes that in a book belonging to so intimate a friend of Joan of Arc, no notice or mention of her appears. But we must remember that poor Joan was burnt at the age of 19, surely the youngest human being who ever attained to so wide a fame, while the Bastard lived to a good old age, and died in his bed full of honours. So perhaps he forgot how much he owed to the heroic maid, who now, after 500 years, is to be made St. Joan.

Dunois died a natural death, as I have said, but such was not the fate of John Talbot, first Earl of Shrewsbury, to whom my next volume belonged. He was killed in battle near Bordeaux, after a lifetime of campaigning, at the age of 65. This book was prepared at Paris at the time of his second marriage, a similar volume being presented, very probably by the Regent Bedford, to his bride, Margaret Beauchamp, daughter of the Earl of Warwick. The books were made long and narrow for convenience of carriage on horseback, like pistols, in a holster. The portraits of the bride and bridegroom (Talbot was about 45 at the date of this, his second marriage), on the first page, represent them kneeling in prayer to the Virgin; their patron saints (St. George and St. Margaret) stand beside them, and the lower part of the page is covered with arms, mottoes, garter, &c., the borders being generally of marguerites or daisies in compliment to the name of the bride. The tradition is that this volume was picked up on the field of battle after Talbot's death. It certainly contains prayers of a special nature, promising safety to whomever has the book in his possession, and there is a pretty prayer, possibly in Talbot's writing, which runs as follows:—

> Jesu, whom ye serve dayly
> Upon your enemys giff you victorye
> Of the holy crosse the vertu
> Your gode fortune alway reneu
> Oure Ladye and Saynt Gabryell
> Geve you long lyffe and gode hele
> And Saynt George the gode Knyght
> Over your fomen geve you might
> And holy Saynt Kateryne
> To your beginnings send gode fyne
> Saynt Christofre boteful on see and land
> Joyfully make you see England.

The opening scene of Margaret's book is just like John's, but smaller and not quite so much battered, and the lower part is identical, except that the arms of the two families have been erased, probably by some one who became at some time improperly possessed of it. A careful scrutiny against the light shows that these also were identical. Margaret's book got into a convent in Luxembourg, the monastery of Epternach, in the seventeenth century, but we have no other trace of its adventures during the 470 years of its existence. The wonderful thing is that, after so many years of separation and wandering these two wedding gifts, for that is what they probably were, should find themselves once more in one another's company on one of my bookshelves.

It has often been said that a very entertaining book might be written on the romance of book collecting. The adventures of the two Talbot Prayer-books, one lost on the battlefield of Castillon, the other long buried in a German convent library, and both happily reunited in the twentieth century, may seem extraordinary enough. But my next story, which is

also the last with which I shall trouble you, is, I think, still more remarkable.

Just three years ago in Wellington-street, Strand, not 500 yards from this hall, there was exposed for sale among the ordinary victims of the auction room, a large square volume containing a MS. of the early part of the fifteenth century. It contained in a French translation the second half of the well-known history of the Antiquities of the Jews by Flavius Josephus. It was bound in a solid red morocco binding of the eighteenth century, such as clothes in the British Museum many of the volumes which formerly belonged to Sir Robert Harley. It had one fine illuminated miniature at the beginning, and had had twelve pages, those at the beginning of each book of the history, cut out with a sharp knife, cut out evidently in a hurry, for the wicked person who thus maltreated the book in his or her haste had cut in many cases the adjoining leaf as well as that which was to be extracted. Otherwise the MS. was a well written book of the period and nothing more. There were, however, certain erasures, places where writing had been scratched out with a sharp instrument. Especially there was one such at the back of the sole surviving miniature, in which a trained eye could just detect a portion of the signature of John, Duc de Berri, the brother King Charles V., the bookloving King of France, who founded the National Library at Paris. Now the Duc de Berri was perhaps the greatest Bibliophil that France ever produced, not excepting the Duc d'Aumale himself, and I was familiar with his writing because he was always careful to write his name in his books, and I was already the possessor of three other volumes which had belonged to him. So I felt that the book was probably in some way or other remarkable; it was at all events interesting from its provenance, and I got a judicious friend to go and buy it for me at the auction, which he accomplished for a very moderate price. Imagine our joy when we got it home. The one picture, though damaged, was a stately production. King Herod, the beau-ideal of a despot, has just entered the Holy City; followed by his knights and himself superbly mounted, he rides through ranks of slaughtered Jews, past the Piscina Probatica, the pool by the sheep-market, in which are seen a number of sick people, and approaches the gate of the Temple inclosure. In the background is an altar for the restored worship of Jehovah. The twisted columns which inclose the altar are identical with those which Raphael subsequently introduced in his famous painting of St. John at the beautiful gate of the Temple, and which Jean Foucquet, the celebrated French painter, the head of the French Primitifs, more than once represented in miniature, especially in the Book of Hours of Etienne Chevallier, which is one of the precious monuments of art preserved in the magnificent Chateau of Chantilly, and for forty pages of which the Duc d'Aumale gave £10,000. It subsequently formed part of his munificent gift to the French nation. The occurrence of these twisted columns in the Herod picture, as well as the general style of the drawing, made us think at once of Jean Foucquet as the possible painter, But the writing in our MS. was nearly a century earlier than the date of Foucquet. How was this to be accounted for?

We next turned to the last page of our volume, where a good deal of writing had been obliterated. In the top right-hand corner were the final words of the book—we read, "Cy fine le livre de Josephe contenant en tout XXVII livres historiaux." Here ends the Book of Josephus, containing in all 27 historiated books. A further inscription at the bottom of the page stated that in this—the second--volume there were 13 illuminations. Now in my second volume, as a matter of fact, there was only one, that of King Herod. Twelve there remained to be accounted for in the second volume, and somewhere or other there should be found the first volume with its 14 pictures. Two conundrums were thus proposed to us. First, where was Vol. I.? Secondly, where were the 12 pages with their pictures which were missing in Vol. II.? The blank page where some writing had been obliterated revealed the mystery. You may know that there exists in chemistry a substance, dear to book collectors, and known as hydro-sulphuret of ammonia. It is made available as a liquid, and with a camel-hair brush and a careful hand you moisten delicately the place on the vellum where writing has been scratched out, and then, as by magic, the erased writing reappears. In the present case two inscriptions came into plain view, which we can read on the photograph taken at the time, though in the three years that have elapsed since the photograph was taken they have almost disappeared again. The inscriptions run as follows:—The first is in the handwriting of the Duc de Berri, and says simply "Ce livre est au duc de Berri," and is signed "Jehan."

The second, a little more difficult to read, is as follows:—"Et de presant á son fiz le duc de Nemours, Comte de la Marck," and is signed "Jacques." Underneath is a further inscription which had not been erased, "Pour Carlat." Now these revived inscriptions tell us most of the history of the book. The first shows that it was written for the Duc de Berri, and as he died in 1417 it must have been written before that date. The second tells us that it belonged subsequently to Jacques d'Armagnac, who was beheaded by Louis XI. in 1477. Our next discovery was that the first volume of the book is in the National Library of France and has at the end exactly similar inscriptions. But the revelations do not stop here. After the two inscriptions in Vol. I. occurs another inscription which does not occur in Vol. II., and which is in the handwriting of a certain François Robertet, Secretary of Pierre de Beaujeu, Duc de Bourbon, and states that the first three miniatures (we are speaking of Vol. I.), were by the artist of the Duc de Berri, and the rest by the good painter and illuminator of King Louis XI., Jean Foucquet of Tours. It is, therefore, established that the whole book was written, and the first three paintings in Vol. I. made for the Duc de Berri; that the book then descended to his grandson, the Duc de Nemours, and was kept by him in his Castle of Carlat (Carlat was on a high hill in the Department of Cantal, not far from Aurillac), that Jacques d'Armagnac had the paintings in the first volume, and presumably also in the second, completed by Jean Foucquet; that, when Jacques d'Armagnac was besieged and made prisoner in Carlat by Louis XI., and executed in 1477, the book became the property of Louis XI., and when he died Vol. I. fell to his only daughter, Anne of France, and her husband, the Duc de Bourbon, whose secretary described it; that the second volume somehow got separated from the first and wandered to England, where after various vicissitudes it found its way into the library of Colonel Townley, at the end of the eighteenth century (his book-plate is on the first page), and was sold at the sale of his library in 1814. In the catalogue of that sale, when it was sold for a small price, it is stated to contain numerous miniatures. The twelve missing leaves therefore had plainly been abstracted subsequently to the year 1814, and one question only remained to be solved, where were those twelve pages now? I was sanguine enough to hope they might be found, and in an account which I printed of my little discoveries, I appealed to all librarians and collectors, in short to all the bookworms of the world to look for them, and let me know in case they found them. Would you believe it, within two years, Dr. Warner, of the British Museum, discovered ten of them in an album in the King's Library at Windsor Castle. A the risk of tiring you to death, I have gone through this little history, and I conclude this paper with an appeal to my hearers, if ever they meet with two MS. pages from the history of the Jews, one containing a large picture, and one a small one by Jean Foucquet, they will let me hear of them, and merit the thanks of all good bibliophils.

DISCUSSION.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Yates Thompson for his excellent paper, said he was sure the audience would agree with him that the author possessed not only a most beautiful and interesting library, but that he was a most admirable exponent of his treasures. Among the last words of the paper, Mr. Thompson mentioned a circumstance which might seem a little suspicious—that ten of the missing pages of the precious volume described were discovered in an album in the King's Library at Windsor Castle. He hastened to add that he did not put them there, and he hastened also to disclaim for his predecessor any participation in the affair. It was a very curious fact that nobody quite knew how they got to the Library. They were all bound, or rather stuck, in a volume, together with several other loose illuminated pages of no great value. There was a tradition, of which nobody knew very much, that they were given by somebody either to William IV. or Queen Victoria — probably the former. Whether that somebody's name was ever known he was unable to say, but if it was the person who used the sharp penknife and cut the leaves out the book, he should imagine that he kept his identity concealed. The audience could well imagine that Mr. Yates Thompson loved his books; none the less it seemed to him a pity that Volume II. of Jean Foucquet's work should be in England, and that Volume I. should remain in the National Library at Paris. A few weeks ago, therefore, Mr. Thompson approached His Majesty the King, suggesting that possibly he might care to add the ten pages preserved at Windsor—he might call them the gems—to the rest of the book—the setting—and that not only as a matter of artistic service, but as a matter of loyalty and friendship towards an old enemy, but now a very great friend, the King should return Volume II. to the side of Volume I., from which it had been divorced for 400 years. The King had not read Mr. Yates Thomp-

son's letter more than half through when he said, "These pages ought to go back to Paris." The leaves had, therefore, been placed in the care of Mr. Yates Thompson to be re-inserted into the volume from which they were taken; and thus, after a long interval the ten pages, and, he hoped, ultimately the two still missing pages, would be re-united in the volume. But, in any case, within two weeks or so, Volume II., of "Les Anciennetés des Juifs," after 400 years of separation, would be placed alongside Volume I., in the National Library at Paris. It was a little bit of romance, which he hoped the French nation would appreciate as much as the present owners of the volume, His Majesty the King and Mr. Yates Thompson.

The resolution of thanks having been carried unanimously,

Mr. YATES THOMPSON, in reply, after thanking the members for the cordial manner in which the vote had been passed, said he was quite certain, from his knowledge of the French literary world, that it would highly esteem the King's kindness in taking the principal part in the small gift which was to be made. It appeared small to people in England, but the rage in Paris for Jean Foucquet as a painter, as shown by the recent collection of the Primitifs, was something quite astonishing. French people were very proud of him, and would very much indeed value the acquisition of the eleven *bonâ-fide* Foucquet paintings, which he hoped would soon be given to them.

Messrs. J. and J. LEIGHTON write:—It may interest the readers of the *Journal* to know that the Josephus MS., His Majesty and Mr. Yates Thompson so graciously propose returning to Paris was sold in March, 1898, at Messrs. Puttick and Simpson's in Mr. J. H. Johnson's sale, where we bought it. We sold it to a collector who after five years desired to dispose of it. We advised his selling it at Messrs. Sotheby's in hopes of it realising a sum worthy of the MS. In the Townley sale the MS. sold for £84 (with the 13 miniatures). It is curious that in the same sale was another manuscript Josephus "Histoire des Juifs," fol. upon vellum, with numerous miniatures finely executed, which sold for £43 1s.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 7, 1906; DAVID MURRAY, R.A., in the chair.

The following candidates were proposed for election as members of the Society:—

Cross, Miss Margaret, Oakbraes, Godalming, Surrey.
Gregory, Henry Kenyon, Norfolk-house, Stuart-road, Grays, Essex.
Robertson, Rudolph Alexander, Thanai Tea Estate, Dikom P.O., Assam, India.
Salomon, Frederick, 12, Canning-street, Liverpool.

The following candidates were balloted for and duly elected members of the Society:—

Boughton, George, Woodlands, Ryde, Isle of Wight.
Hugo, Dirk de Vos, M.B., Worcester, Cape Colony, South Africa.
James, E. Haughton, Forton, Chard, Somerset.
Ling, Ernest E. L., 60, Wall-street, New York City, U.S.A.
Mukherji, Harendra Krishna, M.A., 54, Sankaripara-road, Bhawanipur, Calcutta, India.
Oliver, William Henry, P.O. Box 27, Luipaards Vlei, Transvaal, South Africa, and 10, Avondale-road, Truro, Cornwall.
Riley, George, Effra Works, South Lambeth-road, S.W.
Robinson, Wilfrid Harold, 44, Bedford-row, W.C.

The CHAIRMAN, in introducing the reader of the paper, said that he was a gentleman whose works he was sure all present were familiar with, embodying, as they did, high qualities of imagination, and also conforming to the accuracies which photography so well laid before one. In Mr. Dollman's work there was a combination of both those elements which it was the function of the present meeting to discuss.

The paper read was—

ART IN PAINTING AND PHOTOGRAPHY.

By J. C. DOLLMAN, A.R.W.S.

A short time ago I received a newspaper cutting from a friend of mine, who knew I was to have the pleasure of addressing you this evening on the subjects of painting and photography. The paragraph it contained was evidently part of a correspondence being conducted in the paper on what were considered to be the rival claims of painting and photography as the exponents of art. The discussion apparently had taken the turn of weighing the claims of the two exponents, who figured in the letter under the title of "The Man with a Conception" and "The Camera Man." As the argument progressed, and the *pros* and *cons* were given, one read of the ultimate triumph of "The Camera Man" and of the eventual downfall to ignominy of "The Man with a Conception" who would, no doubt, it was politely intimated, "finally disappear."

Reference to a matter of comparatively such small importance as this letter, may appear to be slight foundation for a paper concerning our subject, but there is, unfortunately, a good deal being said and printed of a like nature in connection with it; which is only of a mischief-breeding character, that can be for no good, and frequently drags men of repute into an idle argument which they presently regret having embarked upon. Now I submit that all such discussions are irrelevant, and are but a waste of time, for it is foolish to spend energy in disputing who is going to do a thing best while the time so employed might be given to the subject itself. The study of art is the object of both fraternities, and whether the man devoted to that object elects to work with the palette, or the camera, he must remember that he is engaged upon the study of a serious and beautiful subject, and realise the fact that its followers have far more to gain by working in unity than they could ever achieve by disputing on the way. If the art of futurity is to be produced by the camera, well and good; let us be thankful to know that the future *will* contain art. But if such be the case, that the camera be the instrument of it, it will still require to be handled by a man with conception, for, as we know, art is found only in the personality of the individual and does not depend upon any special apparatus. In the meantime let all followers of art assist each other, for it is a profession which enjoys the dignity of standing by itself, in this kingdom, without assistance, and with not too much of encouragement, for the spirit of the age is a commercial one, and the public moneys are utilised by the State for the construction of huge engines of war for the protection and development of this spirit, leaving the gentler arts of peace to shift for themselves.

Art itself at the present day, or, perhaps, rather pictorial art, is in a somewhat eruptive condition, and it might be advantageous for us to give a short time to its consideration. Periodically, for all time, the art of painting has been subject to the vigorous action taken by groups of strong men who have felt called upon to assert their independent views, and to act in concert in supporting them. These groups of men have always been so vital in their work, and have so tenaciously adhered to their aims, that in course of time they attain to the dignity of being entitled "schools." The particular individuality of each of these schools is always associated with the emphatic insistence upon one or other of the canons of art at the expense of the remainder. Either forcible dwelling upon the quality of detail alone, or tone, colour, light and shade, or general effect. There are those among us who can remember the appearance of schools affecting all these features, back to the "Pre-Raphaelite" body, whose passion was excessive detail. These movements are generally well timed, and indeed may be considered to be the natural outcome of their age, the calling attention to some weak point in the art of the period; and, even if, in the enthusiasm of the quest, its votaries outstrip the bounds of moderation, the gain to the common cause is great.

The movement of the present day we are all familiar with, under the title of "Impressionism." Impressionism differs from the schools that have preceded it in the fact that it makes no effort in the direction of adding to the existing practice of painting. On the contrary, it subtracts a good deal from it. It contents itself with a memorandum of the effect, and avoids the risk of contending with other qualities. The principal notes are struck, and left, without any gradation or attempt at delicacy or detail, the resulting effort, regarded as a picture, stops short just where difficulty begins — that of showing knowledge and management in the more subtle passages of the painter's art. The canvases are really beginnings of pictures, left in the state which has been known from all time among painters as the "laying in" stage. The facility of execution which this class of work offers the painter is necessarily effective, decoratively; and a certain number of imitators, captivated by its facility and novelty, are following the lead given, as other men have followed other leads—mistaking a part for the whole, and they will have the misfortune of leaving no art legacy behind them. But the sobering influence of time in all these cases is the healer, and though, in the course of nature, the dying out of the school of the day makes room for that of the next, the good which *is* found in them is duly gathered by, and incorporated into, the beautiful things we know as art. So those of us who aspire to know of art, in its larger sense, must put ourselves outside the influences of these factions, as sole teachers, and turn to the truly great achievements of the past. As form is undoubtedly the greatest and strongest element in art so is the sculpture of ancient

Greece the finest art the world has ever seen, or may see. What has been lost to us in the destruction of the paintings of this period we shall never know, but we have the masterpieces of the Italian, Spanish and Dutch schools for our guides. The great elements of the work of these masters appeal alike to the painter and photographer ; the same lessons in strenuous constructive lines, masses of light and shade, and harmony of colour.

Apart from these giants in art of the past, we have more modern painters, men of our own time and country, whose work is worthy of ranking with the highest. It is not the fashion just now to dilate upon the work of those three great painters of our English school, George Mason, Frederick Walker, and Sir John Millais, but their position is an undying one, and to them mainly the modern art of this country owes its glorious heritage of colour, which not long since made English art respected throughout the world. This legacy has been neglected of late years, and has suffered from the imitations of foreign methods, which have unfortunately tainted the inspirations of many men whose pride it should have been to uphold the reputation of what can almost be considered a trust left in their charge. Let us strive at all events to be original, not alone in a national sense, but as applied to the individual. No man yet obtained the respect of his fellows by founding himself upon another. It is so easy a thing, and so poor a thing, to be an echo.

Modern photography has every reason to be warmly congratulated upon the great strides it has made, not only in matters pertaining to its scientific side, but also in the more important one of artistic quality. In the pictures of landscape we have a simple rendering of nature without any desire to dress it up, or prettify it, which is most healthful. The coming to the front of this appreciation of simple dignified subject matter is a striking feature in the advance of late years. Landscape photography of this order is the outcome of the most careful study, for the inexorable lines of nature cannot be moved, and any incongruity can only be circumvented by discriminating choice of the point of sight. Sometimes this has not been overcome, because, apparently, it could not be overcome, while retaining some important feature necessary to the picture. The difficulty of control of the subject is, doubtless, the stumbling block in the way of landscape photography; but when we remember that these very many fine things have been produced, under hampering restriction, the prospect of what might be possible in directions, where the artist had greater facilities, is of the utmost interest. The representations we have of studies of the sea are very impressive, particularly those which are not too sharp in their definition, and where the sense of movement has not been checked by a metallic crispness. In these we can estimate the beauty of the drawing seen in tumbling water, and the character and form of the masses of flying spray. Some of these breaking seas are splendid things. Many of the scenes showing the effect of evening are pleasing enough, though the prevailing tendency is to indulge somewhat too freely in indistinctness of focus, or some granular process is employed in the making of the prints, which invests the entire picture with the same quality. Nature always has a decisive note somewhere, of more or less emphasis. The work done in the direction of interiors is, with the facilities offered by the use of modern apparatus, most perfect as a record of the image before it. The figure subjects that one sees are fewer in number than the landscapes, but are perhaps the more attractive in one sense, for the photographer has greater responsibility here in his personal conception and arrangement of them, and his capacity as an artist is more directly brought before us. Many of these subjects are excellent, and some contain aims of a high order which would seem to forecast the future of photography. For this is the direction in which the art ought to be strong enough to assert itself, where it can dominate its subject, and invest it with the creative.

In the commercial world photography is playing a strong part for the publishers, and in the direction of illustrated journalism there is no doubt that it is doing a useful thing. I think that we must all admit that the *bonâ fide* character of a photographic picture, which illustrates a topical subject, is one of far greater interest than the one of idealised treatment which we were familiar with in the past. We are bound to respect such pictures as fact, as true representations of the incidents depicted, which is exactly what is wanted for the purpose. We want in such cases to know what the incident was like, not what another man thought it was like. These matters, however, do not pertain to art, though there is one phase of such photographic work which has done an immense service to the world, and

that is, it has enabled those who live thousands of miles away to have a complete image of people and countries they may never hope to see personally. Photography has practically brought to every country a true picture of all others. To Science, as well as Art, this is a great gift, not to mention the unspeakable interest to many thousands of families who are scattered widely apart. This is the great feather in the cap of photography.

One of the reasons of the greatness of art in the past is found in the fact that people lived in times when they were surrounded by the beautiful to a far greater extent than at the present day, and they became so familiar with it that a high standard of appreciation was reached, not only by the exponents of art, but by the public itself. In Greece the human figure was of course the dominant influence, in Italy the fine personality and grandeur of costume, in Holland and Spain the characteristic and the picturesque. Modern life cannot permit these surroundings, but the representations of such things hanging upon the wall, as painted by the great men of those times, produced an instructive influence which should be found in all establishments devoted to art. I am, unfortunately, rather ignorant of the methods of education which prevail among photographic societies, and my knowledge of photography of to-day is founded to a great extent upon the exhibitions of pictures that are seen annually on view in London. The scientific side of the subject evidently is well provided for, but one often wonders whether there is a course of training in art pursued in the societies, independently of the use of the camera itself. The student in painting is for some years occupied in schools of art, or the studios of painters, learning not only his craftsmanship, but educating his taste and forming his standard of beauty, in the study of the fine examples of art he finds placed before him. The importance of this can be hardly overestimated. A man's cultured taste is not born with him. He, of course, may be born with a gift for art, but that gift is profitless unless it is educated and developed. Art is a most serious as well as a most beautiful study, and the student not only has to master the executive of his profession, whether with the palette or the camera, but he has to learn to compare, and mature his judgment to be able to select, for selection is the great principle of art. A landscape painter who has been drilled in the schools can apply the principles he has mastered there to the real work of his life—landscape painting—equally well with the man who intends to paint the figure. This would appear to be a vital element in the education of a student who is aspiring to produce works of art with the camera, for he, unlike the painter, has not the power of alteration or elimination when once the photographic plate is exposed. He therefore has to use the keenest judgment and taste in the preparation of his subject beforehand, which must necessarily be a most difficult thing to do, and will test his knowledge of art in a high degree. I am, of course, here alluding to the treatment of the figure subject, for with landscape the power of creation does not lend itself so freely to photography, and beyond the choice of point of sight, and the waiting for the appearance of a satisfactory effect upon the scene, the scope afforded to the photographer for the exercise of the creative is limited by the intractability of his subject.

I do not know whether there exists such an institution as a photographic school for students to study from the living model, but such a school must undoubtedly prove of much value; and in the study of the works of masters, by grouping human figures with an exact fidelity to resemblance, pose, lighting, and detail to the original picture, under the tuition of a photographer who was a master of the art side of the matter, an opportunity of a most instructive nature would be found. If this idea should be new it may possibly not produce a favourable impression, for few innovations do. Personally, I believe that the greatest things that photography is going to do in the future will be associated with the figure; for, in connection with that, the photographer will have the best opportunity of developing and showing his creative power in art, and it is this very quality of the creative which is the charm. When we remember the exquisite modelling of flesh and the tenderness of tone which a good photograph can give, it seems a great loss that these qualities are not made available to the full extent. A student trained in art, working with fastidious care in selecting his model, and in conducting the whole operations, would, I am persuaded, if he was a man with an imagination, produce some photographic pictures which would cause a sensation. The actor's is an art—how much greater to make a figure so perfectly play a part that the resulting study should be received as a great picture. Beautiful as quantities of the landscapes are, which are seen in photographic exhibitions, they are

the art imitative compared with the results which are possible in this direction, at the hands of the right man. If the day should come when a man, with the conception and insight of our painter, G. F. Watts, and who combines that power with a photographic executive of the greatness of Mrs. Margaret Cameron's, the world will see for the first time what it is possible for photography to achieve.

But the pursuit of pure art is a thorny path to tread, and, if a poor man essays to venture his fate in this direction he must do so prepared to lead a life of stern self-denial and extreme patience. Even then he may have to contend not only with vicissitude, but with actual want; for recognition even of a truly distinguished man comes sometimes so late in life as to be valueless to him. A sadder case of this kind it is difficult to quote than the Frenchman, J. F. Millet, the painter of "The Angelus." As there may be some present who are not acquainted with the struggle this eminent man had, perhaps a few facts from his life may be enlightening. The extracts are from Millet's life by his friend Sensier, which is to be found in Vol. XX. of *Scribner's Monthly*. Sensier relates how Millet, though leading the simple life of a peasant, could barely obtain the necessaries of life for his family, and this was mainly done by his painting signboards for a few francs each, struggling to pay off his debts to the local tradesmen for their daily food. "Amidst these miseries," says Sensier, his head always ill, and disquiet and fear always following him, Millet painted his most beautiful works — 'The Gleaners,' 'The Angelus,' and 'Waiting.'"

"The Angelus" was painted in 1859, and sent to Paris, where it lay two months without an offer being made for it. This year he writes to Sensier:—

"It is frightful to be stripped naked before such people, not so much for one's pride, which of course suffers, as because it is impossible to get what we need. We have wood for only one or two days, and we do not know how to get it, as they will not give it to us without money. I am suffering and sad. Forgive me for telling you these things. I do not pretend to be more unfortunate than a lot of other people, but each feels his own pain. . . . I am working on the drawings of Alfred Feydeau, whose money I beg you to send as soon as you get it, for the children cannot be without a fire. Try my dear Sensier, to coin some money with my pictures; sell them at any price, but send me one hundred francs, fifty, or even thirty."

Thirty francs!—twenty-five shillings!

This was the year he painted "The Angelus." He died, as Sensier says, "killed before his time by the endless battles in which his strength could not but fail." This is, I am afraid, very gloomy reading, but it is far from counting as the solitary instance of the world's greatest treasures being wrung from suffering humanity. It is an account which does not apparently encourage a novice to try his fortune in the same direction. But to such a man as this work was more important than life, and the world reaps the benefit, however much it may commiserate the sufferings of his family and himself.

I should like to make a few remarks upon one or two subjects, as a painter, though the subject-matter is more or less photographic. The first of these is what is called "Instantaneous Photography," Some time ago we had a visit paid to this country by a lecturer whose wonderful photographs of moving animals immediately arrested the attention of artists of all kinds. If the lecturer had contented himself with his own department, the photographic analysis of the movement of animals, all would have been well, but he demonstrated by single records of action, that is to say the action that is found in the 1-500th part of a second, that the movement shown in the pictures of animals by Landseer, by Rosa Bonheur, and others, was incorrect. This is another example of mistaking a part for the whole. It is the object of art, in representing movement, to communicate to the senses of the spectator the sensation of movement as it appears to the human eye, and not as it appears to a photographic lens worked by a shutter at 1-500th part of a second. For instance, if a cart wheel, revolving quickly, is photographed by such a quick apparatus the resulting picture conveys the idea of a wheel at rest, for every spoke and detail is sharply defined. But contrast with this the conventional way of drawing a wheel revolving, a circle with a few irregular radiating lines proceeding from its centre, and you at once get the sentiment of motion. This is art. The other is mechanics. When the series of pictures was shown, one at a time, the quaint and extraordinary action of the horses provoked the audiences to amusement; yet when they were shown in quick rotation, in the biograph, and gave, in their combination, the suggestion of action which the human eye can appreciate, the applause of the spectators testified their pleasure. This is to be said of all represen-

tation of movement by Art — that they shall convey only to the eye what the eye is limited to seeing. Analytical demonstration beyond this steps out of the domain of Art into that of Science. It is the duty of Art to represent the typical and not the exceptional. Please do not gather from this that I am not alive to the intense interest which subjects taken with the hand camera always possess. The photographs so taken must certainly appeal to every lover of Nature—if they have had enough exposure.

Another subject I should like to dwell upon is the photograpic portrait, taken direct, on a fairly large scale. These portraits sometimes have a certain quality about them which prevents them being accepted as successful likenesses, although the expression is admitted to be natural, and the features individually faithful in identity. Now I would submit the opinion that this is the result of the camera being brought too close to the subject, and therefore exaggerating the perspective view of the face. While the human vision consists, as it does, of the combined images of the two eyes, the vision of the camera depends upon its single lens; and though a perfectly satisfactory image can be obtained, at a certain distance, by the two human eyes, because, from their different positions, they are able to look more or less round the sides of an object, the camera lens has but one point of sight, and, from the same distance, would yield a very different image, because it does not see round the sides of the object. This leads to undue prominence being given to the nose and front planes of the face. As an illustration of what is meant, let us suppose a view taken, of the front face of a human head as a model, so close to it that the ears would not be seen by the photographic lens, as they would lie behind the projecting cheeks of the face. The two human eyes, at the same distance from the face of the model, would see a portion of the ears, because from their two points of sight they would see round the cheeks of the model to some extent. The point of sight therefore for the photographic lens to be placed, to obtain the same view as that of human vision, is at the apex of the cone of rays which includes the visual angles of the two human eyes. The stereoscopic camera, with its twin lenses placed apart, as human eyes are, would obtain the same view of the model as the human vision—that is to say the combination of its two pictures would give the same view. This illustration is of course a much exaggerated one, but portraiture is such a subtle thing that the slightest variation in the proportion of the features is to be guarded against as a disturbing influence, and this difference between the human vision and what we may call that of the camera, should be remembered at all points of sight.

The other subject I will touch upon before concluding is that of diffused light seen in the interiors of buildings. Photographers have a wholesome dread of the quality which is called "halation," and, while it certainly is an eyesore to see the tracery of a window obliterated by a flood of bright light, I really think it is quite as uncomfortable to have the detail of a window sharply picked out like the working drawing of an architect. The effect of diffused light about the interior of a cathedral is a most poetic element, and is one which some of our great interior painters have seized upon to construct their pictures with. Perhaps a medium course between the two extremes would be the safest one to adopt. At all events, if the photographer wants to make a picture, and not a portrait, of an interior, let him avail himself of this opportunity of obtaining such beautiful gradation of tone as the occasion offers.

It is this very quality of luminous haze that was so largely employed by Turner in the beautiful sunset scenes of his, in which he deliberately introduced the sun itself, and made magnificent use of the play of light upon the atmosphere, in managing the effect of his picture. It is well to speak of this great man Turner as an "Impressionist," for that he most certainly was, in the fullest sense, for he conveyed not only a most gorgeous impression of the effect of the scene represented, but also the detailed impression of the most infinite number of subtle gradations in the beautiful tones of distances, from the delicate film of the extreme horizon to the strong and full-blooded modelling of the foreground of his picture.

I have tried to discuss our subject by a high standard, which is the only one possible to take with the question of art, and it is the standard that all serious aspirants have to abide by in our profession.

It is a beautiful profession, and is, to a great extent, like virtue, it own reward. All that we, the members of it, can do, in its furtherance, is to strive to hold the mirror up to Nature; to tell the truth, the *whole* truth, and nothing but the truth.

DISCUSSION.

The Rev. F. C. Lambert expressed the great appreciation he felt of the tolerant and sympathetic manner in which the author had dealt with a profoundly interesting question. The author impressed him strongly as a painter and photographer, as the usual tirades indulged in by painters against photographers, and by photographers against painters, were avoided. There was always a likelihood that with a little wider knowledge, both might be seen to be partly wrong, and both partly right. No man's methods completely exhausted all the virtues and all the truth, although possibly a greater sum of virtues and truth could be obtained by taking the best that could be found. He was glad to hear that the greatest promise of pictorial photography lay in figure work, a view which he (Mr. Lambert) had supported on several occasions in various photographic societies. He was not always much supported, but the minority were not always in the wrong, and possibly the future might prove that artistic photography would do some of its best work in that direction. He was pleased to hear the recommendation that an artist in any branch should know something of all the other branches. No three-legged stool stood upon one leg, neither did any art stand alone. Some years ago he read a paper at one of the photographic societies on the subject of Pheidias and photography. It was a far cry from the old Greek sculptor of 300 B.C. to the present day, but if a principle were sound it was not a question of what century it was practised in, nor whether it were practised by the pencil, or the camera, or the brush, or the pen; the same principles applied in all cases. He also insisted on the point made by the author that man's cultivated taste was something which required actual cultivation. At the present day there was a tendency to talk much of what he regarded as nonsense about genius. He considered genius as synonymous with hard work, steady application, and earnestness and singleness of purpose, not being afraid to think one's own thoughts, and work in one's own way. The seed required the warmth of sympathy as well as the light of a little wide education. When the author spoke of the impossibility of altering a photograph after the exposure, he (Mr. Lambert) feared he did not know all the arts and tricks which some photographers used in the present day. It would almost shock him to know that some landscapes were made up of half-a-dozen pictures from half-a-dozen counties on entirely different days and under various conditions of light. The suggestion for the establishment of a school for the study of the living figure was not new, but he was glad to see it revived. He believed that in the introduction of figure work, photography would do its best work in the future.

Mr. Philip Newman joined in the expression of appreciation of the paper, which dealt with two subjects which should be friendly but upon which so much had been expressed which was antipathetic. He endorsed all that the author had said.

Mr. Matthew Webb said the audience had listened to a gentleman who, above all, was an artist, and he asked himself whether the audience were artists or photographers. He seemed to have been listening to a plea for the art of photography by a photographer. He knew that was not so, however. If the art of painting was not an art in a sense with which photography had nothing to do, the sooner painting was done with as a foolish plaything of the human race the better. But he especially asked himself, was it true that a man engaged on such a splendid research as photography bothered himself with the question as to whether he was an artist at all? He wondered the photographer was not too proud to be called an artist. But on the other hand he could not conceive how a man who himself knew what art was, as a painter who knew what there was in and at the back of the word "art" could, for a moment, entertain the comparison between art photography and art painting. There was art in photography, but in that sense there seemed to him to be more art in making a camera, more conception in it, than in taking a photograph. The author spoke of a high standard, but he (Mr. Webb) thought a higher standard still should be taken. Had that been so the audience would not have had that paper. He held no brief for impressionism; he could say worse things against impressionism than the author had done. He felt sure that Mr. Dollman would be the first to admit that he had not said all that could be said against impressionism, nor yet all that could be said in its favour. He did not believe that it was correct to speak of it merely as a negation. Finally, if what had been listened to that evening were true, and if nothing else besides were true, then the end of painting was within measureable distance, and the art of the future, even of the comparatively near future, would not include painting.

The Chairman paid a high tribute for the excellent paper which had been read, and said he would take the opportunity, which he had never previously enjoyed, of expressing his views on the subject. He wished to ventilate his own delight in that most interesting pursuit, photography. When science sprang upon art that wonderful invention there was great alarm felt everywhere, and nowhere more than among portrait painters. There existed a letter from Sir William Beechey imploring the Lunar Society, one of the earliest of the photographic societies, to suppress their discovery, as otherwise the portrait-painter's profession would be ruined. Now quietly, gently, and absolutely, that alarm had subsided, and photography had proved to be a good friend to the portrait painter. But it had been a foe to him in some respects. The portrait painters had been in the habit of abandoning themselves fearlessly to portraiture as the expression of lines and quantities of grace, but they were compelled by the mirror which photography presented to them to give details which hampered them in much that was valuable and

essential in art. He knew some portrait painters who had gone so far as to adopt photography as a basis of their work. Some had had a photograph of the sitter enlarged on to the canvas; they were almost compelled to do that because of the poverty of their powers of drawing. Some landscape painters had been addicted to the same habit. But he knew some portrait painters who were as infallible as the camera, almost, in their power to draw, yet who availed themselves of the photograph so that no fact should be omitted. He regretted that because it showed a tendency to cram the picture with details which were not essential factors. Of course the camera was a great aid to the landscape painter, but he did not feel at home with it. If he could catch the ever changing clouds with it he would utilise that and discard the rest. Photography had been extraordinary serviceable in that it had enabled us to bring together reproductions from the finest collections of art throughout the world, and he had recently seen a huge volume of photographs of master-pieces in continental galleries, and had been amazed at the perfection of the photography when employed by a man who obviously must have been an artist. Every fact of interest worthy of the painter's attention was given, the quality of the canvas, the impress to the sweep of the brush, and the particular form of a chosen touch, as well as the time records on the surface. No man who had not the artistic instinct in a high degree could have taken such photographs. The only thing which seemed to be wanting was that precious thing—colour. Yet, even colour seemed shortly likely to be embraced in the triumphs of the man with the camera. He had found great delight in Cassell's publication, "The Nation's Pictures," which was issued at a very cheap rate. He did not say the colours were perfect, but they, at any rate, served to recall the actual pictures to those who had seen them. Some of the colour reproductions were extremely beautiful. With regard to the question of art in photography, Mr. Dollman had treated that part of the subject very well. The value of art training had been enlarged upon, and he agreed with it. He spoke highly of the valuable magazine, "The Studio," and he had been amazed at how near some of those reproductions were to the work of first-rate artists. Some of the pictures showed that a photographer might be a great artist. He did not see why the resources which were indicated by Mr. Lambert should not be employed by the skilful and wise artist. There could not be too many aids to absolute goodness. He spoke in terms of great admiration of Turner's work, whom he described as that great giant on art, the biggest man in art in any realm of any time. The photographer as well as the artist might despair of ever being able to combine effects so beautiful as he had. He hoped there would always be impressionists, though the great bulk of them were not good, interesting, nor valuable. Many of them were impressionists because they could be nothing more; a half-finished or three-quarter-finished statement or conception in art was the most they could achieve, and they seemed proud of it. A perfunctory fashion of treating the most delicate truths was not to be recommended, certainly not to the student. When master minds came to treat their work in an impressionist fashion it was on the strength of well-based knowledge and a large facility of handling, and they were therefore entitled to it. Inspired by Turner's work, very many impressionists sought a path of their own, and the latest stage in Turner's art attracted them. It began by a number of French impressionists finding Turner's work so interesting that they resolved to work upon the methods which he had adopted, and introduce the spectral tints all through their work. None had done that more intelligently, honestly, and perseveringly than Claude Monët. But when one gave all credit to his performances, one must admit with regret that Claude Monët had not painted pictures, but had painted wonderfully interesting exercises. Shall the day come when these exercises will result in great pictures? He would like to see that school abandon somewhat the practice of the prismatic tinting, and see the tinting controlled to one general aspect which would represent atmosphere as Turner represented it. Turner's work, with its wonderful compositions, its great artistic as well as scientific joy in colour, and its lovely surfaces of paint, delighted and convinced and remained with us for all time, ever growing greater as our own knowledge extended. The camera had its triumphs and its future, and he hoped it would ever extend its usefulness and progress. The chemical knowledge in connection with the camera seemed to be acquired by everyone with equal facility, and now there remained a careful study of the art side of the question. He concluded by proposing a very hearty vote of thanks to the reader of the paper, which was carried unanimously.

Mr. Dollman, in reply, expressed his thanks for the vote whieh had been accorded him, and for the lenient way in which his paper had been treated in the discussion. With regard to combination-printing in photography, it appeared to be a matter of great responsibility to do such a thing. He did not pretend to be an expert in photography, but he realised the fact that in Nature when one looked at a scene a certain scheme existed of light and shadow and tone, to interfere with which was in some measure to run the risk of marring it in its entirety. With regard to mechanical work on the negative, that would appear to produce a hybrid example of art for which at present there was no want, and it scarcely came under the subject for discussion. His aim in the paper was a conscientious effort to tell the truth from the points of view of the photographer and the painter, as the most serviceable way of bringing them together. He saw more in Nature than the impressionist did, and he could not recommend to anyone that which he did not believe in himself.

BARRY CENTENARY.—1806-1906.

On the 22nd of February, 1806, died James Barry, the eminent painter, at the age of sixty-five, and on March 7th—the night before his burial in the crypt of St. Paul's Cathedral—the body lay in state in the meeting room of the Society of Arts, just one century ago.

From 1777, until his death in 1806, Barry was in intimate connection with the Society, and this connection of nearly thirty years is equally honourable to both parties, for Barry, who quarrelled with most of his friends, always held the Society in high esteem, and the Society did not forget the artist who had devoted himself to its service.

The painter, from his earliest years, was filled with a desire to devote himself to restoration Fine Art in Britain to its proper place, but he did not obtain his desire at once. His father, at different portions of his life, filled the position of a builder, a sea captain, and a public-house keeper. James went to sea with his father, and afterwards painted the sign for his public-house on the quay at Cork Harbour, with Neptune on one side, and a ship of that name on the other. Soon afterwards Barry commenced his artistic career, and, in 1763, when he was twenty-two years of ago, he painted a picture representing the conversion of the King of Cashel by St. Patrick, which was exhibited in Dublin with other pictures by Irishmen, under the auspices of the Dublin Society. This picture attracted much public attention, and secured for the painter the friendship and protection of Edmund Burke, who introduced him to his friends, including Reynolds, Athenian Stuart, and others. The original title of the Dublin Society (now the Royal Dublin Society) was "The Dublin Society for promoting Husbandry and other useful arts in Ireland." It was incorporated in 1749, five years before the formation of the Society of Arts, and the aims of the two institutions were very similar.

The success of the picture exhibited at Dublin in 1763 changed the whole course of Barry's life. Shortly after the exhibition, Burke and his brother privately furnished him with an allowance to enable him to finish in Italy his artistic education begun in Dublin under a Mr. West; this scheme was suggested by Reynolds. In February, 1766, he started for the Continent and remained in Paris until September, when he settled in Rome. During his stay abroad he kept up a correspondence with his patron Burke. In 1771 he returned to England after an absence of five years, mostly spent in Rome. He brought home with him the unfinished picture of "Adam and Eve," which he shortly afterwards finished in England, which is in the possession of the Society of Arts. It is now exhibited at the Victoria and Albert Museum at South Kensington. He came back with high aims but with somewhat heretical views as to the position of artists of the past. He wrote:—"Rubens, Rembrandt, Vandyke, Teniers, and Schalken are without the pale of my church; and though I will not condemn them, yet I must hold no intercourse with them."

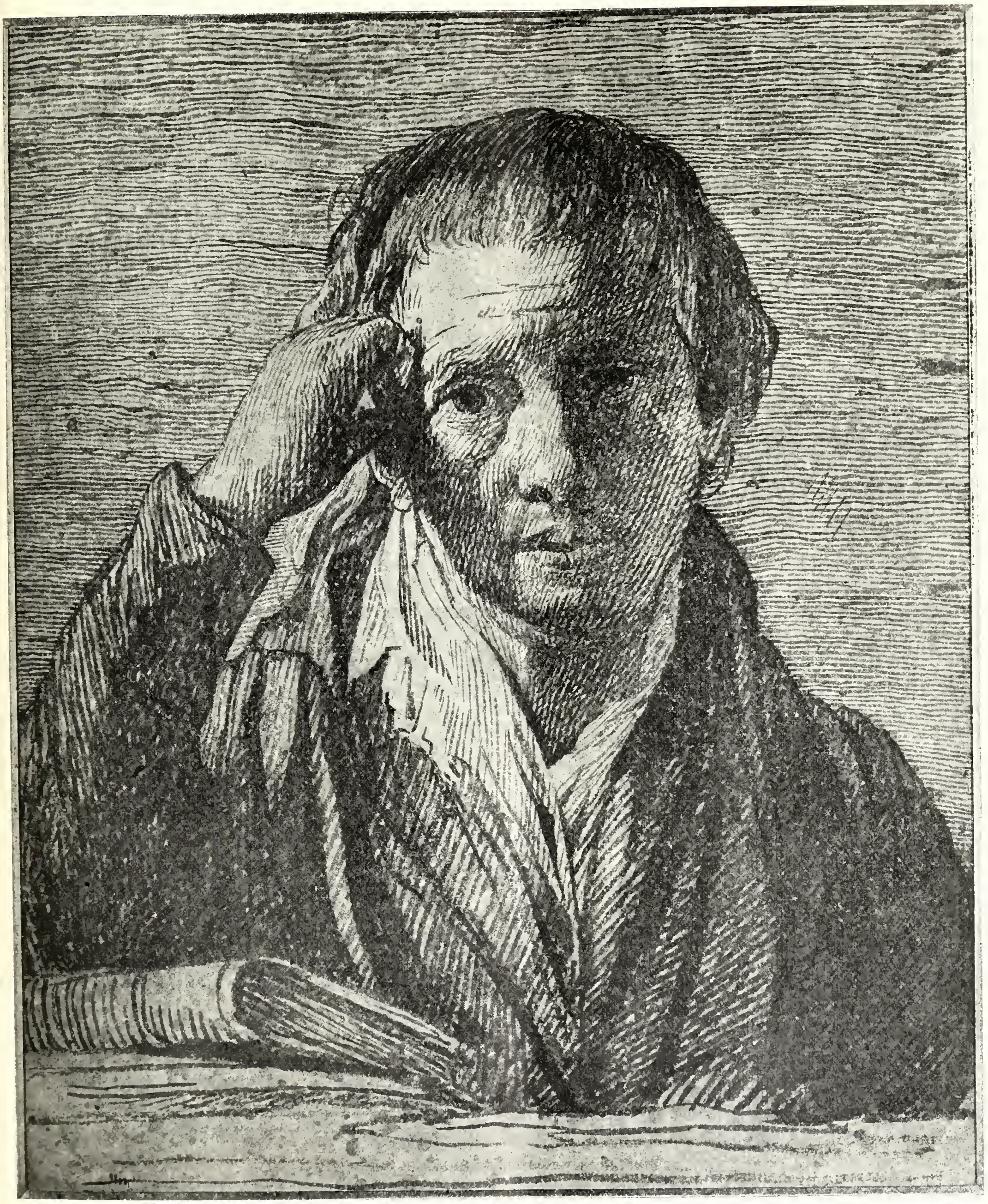
Before his return from Rome, Burke wrote to him to this effect:—"It will not do for a man qualified like you, to be a connoisseur and a sketcher. You must be an artist, and this you cannot be but by drawing with the last degree of correctness. Until you can draw beauty with the last degree of truth and precision, you will not consider yourself possessed of that faculty. This power will not hinder you from passing to the great style when you please, if your character should, as I imagine it will, lead you to that style in preference to the other. But no man can draw perfectly that cannot draw beauty."

In 1773 he was elected a Royal Academician and suggested to the Royal Academy that the academicians should decorate St. Paul's with historical pictures at their own expense. The artists selected were Reynolds, Barry, West, Dance, Angelica Kauffman and Cipriani. After much discussion on the subject the scheme for the decoration of St. Paul's failed.

In the following year the Society of Arts requested, through Mr. Valentine Green the engraver, that certain members of the Royal Academy should ornament the Meeting Room with historical and allegorical paintings. The ten painters who were invited to decorate the room were the same six that are mentioned above in relation to St. Paul's and the names of Mortimer, Wright, Romney, and Penny were added to theirs; but the artists were unable to agree to the request.

Barry was disappointed at the failure of these negotiations, and in 1777 he offered again, through the good offices of Valentine Green, to undertake the whole work himself and to decorate the Great Room "with a series of pictures analogous to the views of the institution." The offer was made anonymously as that of one of the Royal Academicians, and the Society accepted the offer before the name of the artist was known.

When the work was decided upon no time was lost, and by the autumn of 1778, considerable progress had been made, although it was several years before all the pictures were finished. In 1781 frames designed by Barry himself were obtained at a cost of £100 17s., and in 1783 and 1784 public exhibitions of the pictures were held for the benefit of the painter. The exhibition was an important event in London Life, and is recorded by most of the memoir writers of the time; in fact it was the talk of the town. Horace Walpole was greatly struck with the picture of the "Olympic Victors," the figures in which he says "are fairly drawn and graceful, and the whole composition is simple and classic." He makes much fun in his letters to Mason of the variety of figures in the pictures, many of them in incongruous positions. Dr. Burney, he says, "is not only swimming in his clothes, but playing on a harpsichord a new kind of water-music." Johnson said of this exhibition to Boswell, "Whatever the hand may have done, the



Portrait of James Barry from a pen and ink Drawing by himself.

mind has done its part. There is a grasp of mind there which you find nowhere else." Johnson's criticism of the merits of the paintings was probably biassed by his admiration of a friend of Burke, and by his inability to see them distinctly.

Goldsmith was not so complaisant, and, as Forster says, "he used to plunge in art discussion with Barry, and would punish Barry's dislike of Sir Joshua by disputing openly the subtlest dogmas with that irritable genius, or perhaps by laughing secretly as he put in practice a strict adherence to the two rules which formed George Primrose's qualifications for setting up as a cognoscente: "the one always to observe the picture might have been better if the painter had taken more pains, and the other to praise the works of Pietro Perugino."

Barry published elaborate descriptions of the pictures, and the account of them printed in the third volume of the Society's "Transactions" contains words of praise which would be inappropriate if

they came from the painter himself, but they are not to be found in the author's original description.

Burke, who greatly admired the pictures, also wrote anonymously an account of them, which is quoted by Croly in his "Life of Burke" (1840). He, however, hinted at Barry's love for the grandiose when he wrote:—"Let him not imagine that when he has covered a great extent of canvas with bold and hasty sketches he has produced a fine picture or sublime composition."

The exhibitions produced £503 12s., which amount was handed over to Barry. Various additions were made to the pictures almost up to the date of the painter's death.

In 1798-1799 a gold medal and two hundred guineas were given to Barry "in testimony of his public zeal and eminent abilities manifested in the series of pictures in the Great Room of the Society."

On the death of Nelson the Society proposed to commemorate the great man in one of the pictures, and Barry had undertaken to execute the work, but the artist's sudden death prevented this intention from being carried into effect.

Barry was arrogant and of a quarrelsome disposition, but he was not vindictive and he frequently entered again into friendly relations with those he had previously treated as enemies. Fanny Burney said of him, "His passions had no restraint, though I think extremely well of his heart as well as of his understanding." Those who are acquainted with his story will probably agree with her. He had when young been rude to Reynolds, but saw his error afterwards, and on that great man's death he delivered at the Royal Academy a eulogium on Reynolds as a man and as an artist. When in 1794 the Marquis and Marchioness of Thomond (then Lord and Lady Inchiquin) presented him with Reynolds's painting chair, he expressed himself strongly in his reply of thanks. He wrote:—"This chair, that has had such a glorious career of fortune, instrumental as it has been in giving the most advantageous stability to the otherwise fleeting perishable graces of a Lady Sarah Bnnbury or a Waldegrave, or in perpetuating the negligent honest exterior of the authors of 'The Rambler,' 'The Traveller,' and almost everyone to whom the public admiration gave a currency for abilities, beauty, rank, or fashion. The very chair that is immortalised in Mrs. Siddons's tragic muse . . . may rest very well satisfied with the reputation it has gained, and although its present possessor may not be enabled to grace it with any new ornament, yet it can surely count upon finding a most affectionate reverential conversator whilst God shall permit it to remain under his care."

Barry offended the members of the Royal Academy by his reckless condemnation of some of them, and when in 1799 he loaded some of the Academicians with accusations and insults in his letter to the Dilettanti Society, the Academy took action, deprived him of his professor's chair, and expelled him from their body. In consequence, his last years were spent in poverty and seclusion, but he did nothing to forfeit the respect of his fellow men. He rather starved than borrowed from his friends. In May, 1805, a meeting was held at the Society of Arts, when £1,000 was subscribed for his benefit, and with this sum an annuity of £120 was purchased of Sir Robert Peel, but he did not live to enjoy it.

Public opinion which was never entirely at one with Barry himself in the estimation of his genius has now allowed his fame to fall below his merit, but the pictures in the Meeting Room will certainly keep his memory alive. They are full of historical interest owing to the portraits they contain, and their life and vigour cannot fail to give pleasure to all who view them.

This short notice of the life and work of James Barry completed one century ago cannot be better closed than with the words passed by a unanimous vote of the Society on the occasion of his death, "That permission should be given to the persons conducting the funeral of the late Mr. Barry, to place his body in the Great Room of the Society the night previous to his interment, as the last tribute in the power of the Society to offer to the remains of the illustrious artist, to whose labours it is indebted for the series of classical paintings which adorn its walls."

Sir Robert Peel, who profited by the sale of the annuity, gave two hundred pounds to pay for his funeral and to raise a tablet to his memory.

Portraits of Barry.

There are three portraits of Barry in the possession of the Society. 1. The portrait of the artist at the age of about 42 in the character of Timanthes sitting at the foot of Hercules in the picture of the "Victors at Olympia." This was engraved by Heath and published as a frontispiece to the third volume of the Society's Transactions. 2. Oil painting by Barry taken in middle age. 3. Pen and ink drawing made by Barry a few years before his death, which was subsequently etched by him. Charles Warren, the engraver, who bought the drawing at the sale of Barry's effects, wrote:—"I can answer for it being a strong characteristic likeness of that eminent artist and singular man." This likeness is reproduced on page 477.

There are two portraits of Barry in the National Portrait Gallery. 1. Painting by himself as a young man; there are two portraits in the background which represent his fellow students—Paine the architect and Lefevre a French artist. 2. Drawing in Italian chalk by William Evans from a cast taken late in life. There is another portrait by himself at the Victoria and Albert Museum (Parsons bequest).

HOME INDUSTRIES.

Scientific Research and Industrial Prosperity.—Mention was made in these Notes last week of the meeting at the Mansion House to honour Dr. Perkin,

and on Saturday *The Times* published a letter from Professor Sylvanus Thompson which stamps with his high authority the warnings of many of the speakers at that meeting. They said that the lack of sympathy between the capitalist in this country and the scientific workers is making the manufacturers of the United Kingdom mere followers where in times past they led. It is to be feared that it is too late to recover the lost colour industry, but there are two other groups of industries which no less depend upon the adequate cultivation of scientific research, namely, the electrical industry and the manufacture of steel, and these two will be lost to the foreigner unless our steel works are staffed with men scientifically trained, and the torch of research is kept burning brightly, "not in technicial schools or institutions alone, but in the innermost heart of the industries themselves." Professor Thompson directs attention to what he describes as "the perilous state of the electrical industries," and the decadence of pioneering work. Electric pioneering, he says, has largely ceased. Many of the large firms are actually abandoning their experimental works, and cutting down the number of men they employ. "Where are the newer kinds of electric lamps being developed? The Nernst lamp, the flame lamp, the vapour lamp, the oxide lamp, the osmium lamp, the tantalum lamp, all rich in future possibilities, where are they perfected? Not in England." Professor Thompson doubts if there is a single British firm that is spending on development a tenth part of the sum that a single American firm is spending on one thing alone. The answer will be made that for the last six years the British electrical firms have been so busy undercutting one another in prices that they have no means available for maintaining expensive research departments. "Even in the scientific departments of the Universities, and in the best of the technical colleges, the men who might be doing promising work are loaded with administrative and educational duties, and the material facilities for research placed at their disposal are not seldom ludicrously inadequate, or even non-existent."

London and the Indigo Market.—Another correspondent of *The Times* says that at the present time the German colour factories produce over fifty million pounds worth of coal tar colours annually. Some of these factories employ over 200 first-class chemists who have had a thorough preparatory schooling, followed by profound technical University studies. "The sums devoted every year by these German factories to research work are something prodigious in amount, and not dreamt of in any British industrial establishment." Take indigo. The Germans set themselves to kill the production of natural indigo in the British Colonies, and they have largely succeeded. In a few years time Bengal indigo will cease to be produced. In the official "Review of the Trade of India in 1904-5" (Cd. 2750) it is stated that "the unremunerative level to which prices have been forced down by the competition of synthetic indigo has reduced the indigo plantations of Bengal to less than half the area they occupied ten years ago, and over the whole of India the reduction in that period is 66 per cent. . . . The cultivation of indigo in Madras, where the area fell by 49 per cent. in 1904, appears to be rapidly approaching extinction." London has practically ceased to be an indigo market. It used to be its centre. When the British army was first clothed in scarlet, writes the correspondent referred to above, "the colouring matter used was lac dye made in Bengal, simultaneously with shellac, the extract of an Indian plant. It was the fastest scarlet dye known, and could only be used for pure wool, cotton fibres could not be dyed with it. It used to sell at 2s. and 2s. 6d. a pound. Nowadays it is replaced by German-made coal-tar scarlet dyes, and the last old stocks of Indian lac dye were abandoned by the importers, remained in the dock warehouses, and were finally sold at the value of the chests, after the contents were thrown on the rubbish heap. Not a pound of lac dye is now made in India.

Patents and Working.—Mr. Ivan Levinstein holds that British patent law works to the prejudice of British trade. He illustrates his contention by the history of alizarin. The discovery in England and Germany of a commercial process to make artificially a colour hitherto only obtainable from nature's chemistry, viz., alizarin, was made simultaneously in 1870, but whilst patents were granted in this country for a number of processes to produce alizarin not one was granted by the German Patent Office. "The stimulus given to German manufactures by the large demand for alizarin was immense. They combined, and dictating English consumers their own terms, just as they do to-day, they realised for several years a net profit of one million sterling per annum in the sale of this colour alone. By these extraordinary profits they were enabled to write off the cost of their old works, to reconstruct them on the most modern principles, and to build large laboratories, which they manned with an increased number of able and well-paid workers and research chemists." In Mr. Levenstein's opinion there is only one remedy to get back at least some portion of the lost position, and that is "to compel at the risk of forfeiture every British patentee to work his patent in this country on an adequate manufacturing scale, if worked abroad."

The Threatened Coal Strike in America.—The latest news of the coal trade situation in the United States is somewhat more hopeful as to the possibility of avoiding a strike. Statements made by Mr. Patrick Dolan, President of District No. 5 (Pittsburgh) of the United States Workers' organisation, and by President George F. Baer, of the Reading Railway, go to show that the miners have not much to complain about. "Our wages," writes Mr. Dolan, "have been increased more than 100 per cent., and our hours of labour have been decreased from ten to eight hours since 1897." And he asks if it is right to

jeopardise these advantages. Mr. Baer deals with the cost of coal now and before the strikes in the anthracite industry. In 1899, he says, the Reading Coal and Iron Company received 1·713 dols. per ton at the mine. In 1905 it received 2·449 dols. per ton. There was, therefore, an increase in the amount paid of 73·6 cents per ton in seven years. In the same time the cost of mining increased 63·3 cents per ton. Of this, labour received 51·7 cents, and materials cost 11·6 cents more, a total of 63·3 cents per ton, leaving to the coal company an increase of 10·3 cents per ton in seven years.

British Trade with Turkestan.—The British agent in Yarkand gives some particulars in his report for 1904-5 as to the competition of Russian with English goods in Chinese Turkestan that may be usefully noted by British manufacturers. Mr. Macartney points out that the Moscow manufacturer of cottons has successfully imitated patterns of which the Indian trader formerly held the monopoly. Chintzes, muslins, towels, and long-cloths that had become popular in Kashgaria have all been copied, and the local dealers have accepted the imitations. Mr. Macartney writes:—"About a decade ago chintz was a most important item among the imports from India, and then the competition from Russia was far from being as severe as it is now. Circumstances have, however, undergone a complete change. The markets of Chinese Turkestan are simply surcharged with Russian cotton prints, which are now superior in quality and low in price compared with the English production." This would seem to show that the enterprise of the Russian trader, assisted by more favourable customs regulations, is sapping the Indian trade in the Yarkand bazaars. With higher prices ruling in India, consequent on the *Swadashi* movement, the falling off this year is likely to be still more marked. Lancashire might do well to pay more attention to the market beyond Leh, as probably cotton goods will be a brisk demand owing to the shortage from the Moscow mills consequent upon the destruction of property there during the recent rioting.

The Milan Exhibition.—Although there have been no violent fluctuations in the trade between the United Kingdom and Italy during the last few years, there is a tendency to decline, and it may be regretted that manufacturing firms in this country have not shown themselves very desirous of taking advantage of the space offered them at the Milan International Exhibition. It is unlikely that the British display at the Exhibition will be worthy of the United Kingdom, and it would seem that manufacturers are dissatisfied with some of the arrangements of the Executive Committee. It is complained that the committee have granted a monopoly of the supply of exhibition cases to a single firm in this country, whose scale of charges does not commend itself to manufacturers, and it is further complained that the Exhibition authorities at Milan have made an arrangement of a similar character for the carriage of exhibits to and from the Exhibition. Commenting upon these and other complaints *The Times* says that from what it has learnt of the interior regulations of the Exhibition itself, and the rules classifying exhibits, which appear to have been in some respects of a very arbitrary and unreasonable character, "it is to be admitted from this and other points of view that the lack of enthusiasm shown by firms in this country towards the undertaking is not without some reasonable justification." That may be taken for granted, but whoever may be responsible for the cold shoulder given to the Exhibition by British manufacturers there will be regret that the British section is likely to be inadequately represented.

Trade with South America.—It is a little surprising that British trade with Central and South America has held its own so well against the competition of the United States, but what with the occupation of Cuba and the acquisition of Porto Rico, the economic development of Mexico and Argentina, developments in Panama, and the more strenuous insistance upon the Monroe doctrine, American trade with the South has developed rapidly. The total imports of the United States for 1905 were approximately 1,200,000,000 dols., and a quarter of this came from Central and South America, an increase of 50 per cent. over that of ten years ago. American exports to these countries, which in 1895 did not exceed 75,000,000 dols., last year reached a total of over 180,000,000 dols. The South American Republics keep but slovenly statistics but their total import trade is put by the New York *Sun* at not far from 600,000,000 dols. a year, of which the United States secured about 30 per cent. last year, but this is due largely to her big share of the Cuban and Mexican trade. Ten years ago American exports to Mexico did not exceed 15,000,000 dols., last year they were over 51,000,000 dols. Cuba's 13,000,000 dols. purchases of 1895 increased to 44,500,000 dols. in 1905. The exports to Argentina have risen in the same period from 5,000,000 dols. to 12,000,000 dols., Peru and Chili show notable increase in purchases. Bolivia has increased her purchases from 11,000 dols. to 144,450 dols., and only Brazil and Venezula show a decline. Panama with purchases of 7,800,000 dols. is a new factor. These figures show that the Americans are rapidly extending their trade with Central and South America, and our merchants will do well to note the fact. British imports are still well ahead, as for example in Argentina, where they are nearly three times those from the United States, but British trade with these countries will have to reckon in an increasing degree with American competition.

Electro-Technical Industries.—A writer in the *Scientific American* directs attention to the growth of the demand for many common articles of commerce owing to the cheapening of manufacture

due to electro-metallurgy. Thus in the production of aluminium the price has been so reduced in the last few years that it is employed in many new industries, notably in the substitution of aluminium transmission wires for copper in the electrical industries. The new transmission lines are of stranded aluminium, and they carry heavy voltage over great distances. So with copper refining. There are upwards of thirty-two electrolytic copper refineries in operations to-day, and more than half the world's output of copper is refined in these plants. The employment of electricity for the extraction of copper from low-grade ores has also developed, notably in Canada, where the electrical extraction has been successful with ores containing only from 2 to 4 per cent. of copper. The use of the electric furnace in the iron and steel industry is expected to bring about great transformation in smelting, and where electric current is very cheap and abundant, iron ore plentiful, and coal scarce and high-priced, the electric furnace may displace the ordinary blast furnace for the production of pig-iron. The electric furnace promises greater results in the specialised field of making high-class steels and steel alloys from scrap, and in the manufacture of such alloys of iron as ferro-chrome, ferro-silicon, and ferro-titanium, the electric furnace has been very successful. Again there is confident prediction that the electric furnace will effect a revolution in glass manufacture. Such new products as silicon-copper and and siloxicon are the results of the application of the electric furnace to experimental fields. Nickel, lead, tin, and zinc have all come under the power of electricity, and are either refined or extracted from the ore in increasing quantity. Scrap tin and zinc are now recovered by electrolytic processes which make all tin can, tin roof, or tin boiler of potential value.

CORRESPONDENCE.

THE CHEMISTRY OF ARTISTS' COLOURS.

Professor Thomson writes that the Table No. 1 of his paper on page 393 of the *Journal* is based upon the classification originally introduced by Professor A. H. Church, F.R.S., in his lectures to the Royal Academy in 1880, and published in the various editions of his book on the "Chemistry of Paints and Painting."

LONDON TRAFFIC.

Mr. Ernest Benedict wishes to correct the report of his remarks on Captain Swinton's paper (see *ante*, p. 451). Instead of saying that trams were obstructive to slower vehicles but not to faster traffic, what he intended to convey was, that slow traffic obstructed the trams, but the trams did not obstruct the fast traffic.

OBITUARY.

DR. SAMUEL PIERPONT LANGLEY.—Dr. Langley, the eminent astronomer and physicist, Secretary of the Smithsonian Institution, who was elected a honorary corresponding member of the Society of Arts in 1896, died on the 28th ult. He was born at Roxbury, Boston, Mass., on August 22, 1834. For a short time an assistant at Harvard College Observatory, and for one year assistant professor of mathematics at the United States Naval Academy, he held for twenty years the directorship of the Alleghany Observatory at Pittsburg, until in 1887 he was appointed Secretary of the Smithsonian Institution at Washington, which highly-important post he held until his death. He was a graduate of many European and American Universities, D.C.L.Oxon, D.Sc.Cantab, F.R.S. (elected 1895). In *The Times* obituary it is said that "early in his career at Alleghany his attention was drawn to the energy-curve of the solar spectrum, and to the problem of solar radiation he devoted year after year of unremitting study and experiment. He invented his own apparatus, the bolometer, whose sensitiveness is such that it can detect a difference of temperature of one-hundredth-millionth part of a degree Centigrade, and by its means discovering a new spectrum beyond the 'red' far greater in extent than the whole of the visible sprectrum. Realising the drawbacks of the atmosphere at Pittsburg, Dr. Langley made an expedition to Mount Whitney, and demonstrated the value of a mountain station for solar work."

F. J. HORNIMAN.—Mr. Frederick John Horniman, a life member of the Society of Arts since 1872, died on the 5th inst., at his London house in Hyde-park-terrace. He was born at Bridgewater in 1835, and was educated at Friend's College, Croydon. For the greater part of his life he had been a traveller and collector, his travel extending to Canada, the United States, Japan, Ceylon, Burma, India, and China. His collection of curiosities in natural history, arts, and manufactures are in the Horniman Museum, Forest-hill, founded and maintained by him for many years, and presented by him to the London Couuty Council for the use and enjoyment of the people in 1901. He spent £40,000 on this museum for the accommodation of his collections and library. In presenting it to the Conncil he included in the gift his former residence, Surrey-house and grounds, and some other houses.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 14.—"Imperial Organisation from a Business Point of View." By GEOFFREY DRAGE. The RIGHT HON. ALFRED LYTTELTON, K.C., will preside.

MARCH 21.—"Motor Boats." By BERNARD B. REDWOOD, B.A. SIR JOHN I. THORNYCROFT, LL.D., F.R.S., will preside.

MARCH 28.—"Power Transmission and Coal Conservation." By ARTHUR J. MARTIN, M.Inst.C.E.

APRIL 4—"Ramie and its Possibilities." By MRS. ERNEST HART. Illustrated by Samples manufactured by A. M. Hart, Ltd.

MAY 2.—"Submarine Signalling." By J. B. MILLET.

MAY 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By PROFESSOR THOMAS OLIVER, M.D., LL.D.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 15.—"The Languages of India and the Linguistic Survey." By DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit., SIR CHARLES JAMES LYALL, K.C.S.I., C.I.E., LLD., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

MARCH 20.—"English Royal Heraldry." By CYRIL DAVENPORT, F.S.A. WILLIAM A. LINDSAY, K.C., Windsor Herald, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

LECTURE I.—MARCH 12.—The Science of Fire—Ignition—Slow Combustion—Spontaneous Combustion—Results of Combustion—Flame—Smoke—The Oxides of Carbon, and Water Vapour—Causes of Fire and their classification.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Vivian B. Lewes, "Fire, Fire Risks, and Fire Extinction." (Lecture I.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. William Woodward, "The Means of Locomotion and Transport in London."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Mechanical Engineers, Storey's Gate, Westminster, S.W., 8 p.m. (Graduates' Lecture.) Mr. J. H. Hurst, "Design and Construction of large Gas-Engines."

TUESDAY, MARCH 13...Asiatic, 22, Albemarle-street, W., 3 p.m.

Royal Institution, Albermarle-street, W., 5 p.m. Prof. W. Stirling, "Food and Nutrition." (Lecture VI.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. J. J. Webster, "The Widnes and Runcorn Transporter Bridge."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Miss C. de Thierry, "What is our Policy in the West Indies?"

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, MARCH 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Geoffrey Drage, "Imperial Organisation from a Business Point of View."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Association of Engineers in Charge, St. Bride's-Institute, Bride-lane, E.C., 7½ p.m. Mr. G. Bibby, "Ventilation of Public Buildings."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3½ p.m.

THURSDAY, MARCH 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Dr. George A. Grierson, "The Languages of India and the Linguistic Survey."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. Prof. F. W. Oliver, "The Origin of Gymnosperms."

Chemical, Burlington-house, W., 8½ p.m. 1. Messrs. W. A. Bone and G. W. Andrew, "The Interaction of Well-dried Mixtures of Hydrocarbons and Oxygen." 2. Messrs. W. A. Bone and J. Drugman, "The Explosive Combustion of Hydrocarbons." 3. Mr. P. Haas, "The Occurrence of Marsh Gas amongst the Decomposition Products of certain Nitrogenous Bases as a Source of Error in the Determination of Nitrogen by the Absolute Method." 4. Mr. P. W. Robertson, "Studies on Comparative Cryoscopy. Part IV. The Hydrocarbons and their Halogen Derivatives in Phenol Solution." 5. Mr. A. F. Joseph, "The Displacement of Acid Radicles. I. Displacement of the Chloride and Nitrate Radicles."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Francis Darwin, "The Physiology of Plants." (Lecture III.)

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 6½ p.m.

FRIDAY, MARCH 16...Royal Institution, Albemarle-street, W., 9 p.m. Mr. W. Duddell, "How to Improve Telephony."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Cold Wrought Iron" and "The Tempering of Steel."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Discussion on Mr. G. J. Churchward's Paper, "Large Locomotive Boilers." 2. Mr. Louis Greaves, "Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico."

SATURDAY, MARCH 17...Royal Institution, Albermarle-street, W., 3 p.m. Prof. J. J. Thomson, "The Corpuscular Theory of Matter." (Lecture III.)

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FRIDAY, MARCH 16, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 19, 8 p.m. (Cantor Lecture.) PROFESSOR VIVIAN B. LEWES, "Fire, Fire Risks, and Fire Extinction." (Lecture II.)

TUESDAY, MARCH 20, 8 p.m. (Applied Art Section.) CYRIL DAVENPORT, F.S.A., "English Royal Heraldry."

WEDNESDAY, MARCH 21, 8 p.m. (Ordinary Meeting.) BERNARD B. REDWOOD, "Motor Boats."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 12th inst., PROF. VIVIAN B. LEWES, delivered the first lecture of his course on "Fire, Fire Risks, and Fire Extinction."

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, March 15; SIR CHARLES JAMES LYALL, K.C.S.I., C.I.E., LL.D., in the chair. The paper read was "The Languages of India and the Linguistic Survey," by DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Litt.

The paper and report of the discussion will be published in a future number of the *Journal*.

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1906 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before Saturday the 1st April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years :—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For.Memb.R.S., Chevalier of the Legion of Honour, &c.

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B.

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S.

In 1873, to Michel Eugène Chevreul, For.Memb. R.S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For.Memb.R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin.

In 1882, to Louis Pasteur, Member of the Institute of France, For.Memb. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D , F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (afterwards Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (afterwards Lord Masham).

In 1887, to HER MAJESTY QUEEN VICTORIA.

In 1888, to Professor Hermann Louis Helmholtz, For.Memb.R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to William Henry Perkin, F.R.S.

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

In 1894, to Sir Joseph (now Lord) Lister, F.R.S.

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S.

In 1896, to Prof. David Edward Hughes, F.R.S.

In 1897, to George James Symons, F.R.S.

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For.Memb.R.S.

In 1899, to Sir William Crookes, F.R.S.

In 1900, to Henry Wilde, F.R.S.

In 1901, to HIS MAJESTY THE KING.

In 1902, to Professor Alexander Graham Bell.

In 1903, to Sir Charles Augustus Hartley, K.C.M.G.

In 1904, to Walter Crane.

In 1905, to Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 14, 1906; The RIGHT HON. ALFRED LYTTELTON, K.C., in the chair.

The following candidates were proposed for election as members of the Society:—

Barriga, Manuel Diaz, 75-80, Dashwood-house, New Broad-street, E.C.

Champion, Henry Vane, M.Inst.C.E., Equity Trustees-building, 87, Queen-street, Melbourne, Australia.

Cooksley, Alfred, 12, Woodview-gardens, Highgate, N.

Hamilton, Captain James de Courcy, R.N., Headquarters, Fire Brigade, Southwark, S.E.

Kawai, I., Bureau of Camphor Monopolization, Kumoidori, Kobe, Japan.

Kirby, Thomas E., American Art Association, Madison-square South, New York, U.S.A.

Pickering, John William, 76, Clarendon-road, Walthamstow, Essex.

The following candidates were balloted for and duly elected members of the Society:—

Laud, F. B. E., care of Commissioner of Customs, Kowloon, Hong Kong, China.

Muller, Godfrey Henry Emile, Government Electricity Works, Malta.

Pigot, Thomas F., 14, Fitzwilliam-place, Dublin.

Rogers, David Anderson, Balmaine, New South Wales, Australia.

Russell, Frank William, M.A., Dulwich College, S.E., and 4A, Moreton-terrace, Old Brompton-road, S.W.

Shimosé, Masachika, 110, Hakusan—Gotenmachi, Koishikawa, Tokyo, Japan.

Sutton, Gerald John, 50, Woodville-gardens, Ealing, W.

Tarachand, Shavak M., Burlington-house, Cumballa-hill, Bombay, India.

Tindall, Robert, J.P., Ashburn, Fordingbridge, Hants.

Walter, Rev. Frederick William, Burnham Overy Staithe, King's Lynn, Norfolk.

The paper read was—

IMPERIAL ORGANISATION FROM A BUSINESS POINT OF VIEW.

By GEOFFREY DRAGE.

ABSTRACT OF CONTENTS.

I. *Imperial Organisation now a question of Practical Politics.*

II. *Authorities for this Paper.*

III. *Imperial Federation* and kindred movements. Their failure and its causes. New Imperial Defence Committee. Sir F. Pollock's Committee and its proposed *Imperial Organisation*, with an Imperial Advisory Council, and intelligence department for the civil affairs of the Empire, and an Imperial Commission for special enquiries. Proposals adopted by Mr. Lyttelton. His despatch. Mr. Deakin's speech. Postponement of the Colonial Conference. Work to be done in the interval before the Conference.

IV. *Practical Results to be obtained from Imperial Organisation* from a business point of view.

(1) *Uniformity of legislation* throughout the Empire as to naturalisation, patents, trade marks, copyright, currency, weights and measures, partnership, bills of exchange, insolvency, marine insurance, light dues, taxation of commercial travellers, labour legislation. The question of consolidation and codification generally. System and method. The new spirit. An English Justinian.

(2) *Uniformity of Administration.* — Supreme Imperial Court of Justice. Colonial opinion. Precedent of Germany. Overlapping of departments, Foreign Office, Colonial Office, Board of Trade. The collection of commercial statistics of the Empire. Present chaos. Re-organisation of the consular service, its extension to the Colonies. The British business man and the State and the press. Interchange of Colonial Office clerks with colonial officials. Interchange of Indian and Colonial officials. System and method required. Compare Foreign Office, church, or business.

(3) *Re-organisation of the Communications of the Empire.*—Improved postal and telegraphic arrangements. Cable and postal rates. Results to British periodicals. Passengers and goods services. Rates of freight to the Cape and Australia from London, Hamburg, and New York. Foreign subsidies and English shipping. Sir R. Giffen's evidence in favour of the partial re-enactment of the Navigation Laws. Railways in Crown Colonies, *e.g.*, Nigeria.

(4) *Imperial System of Primary and Secondary Education in Seamanship.*—More British seamen for British ships. Canadian policy. Naval reserves.

(5) *The Collection of Information and Co-ordination of Opinions on Matters of high Imperial Policy.*—The Alaskan Question. The New Hebrides. The Union of Canada with the West Indies, of New Zealand with the South Sea Islands. Relations of Canada and Australia.

(6) *The Dissemination of Information on Matters of high Imperial Policy.*—The relations of Great Britain and Russia.

(7) *Continuity of Policy.*—(*a*) Commercial treaties with China; the Mackay treaty of 1902; relations of Trinidad and Venezuela. (*b*) Political. Egypt; South Africa.

V. *Liverpool Chamber of Commerce* resolution, adopted at Leeds and Manchester, placed on the Agenda for the Congress of Chambers of Commerce of the Empire. It is no party question. Appreciation of recent work.

The New Spirit and Mr. Haldane's Speech. We want more method and more thinking. Retrospect. Appeal for placing colonial questions above party.

Mr. Lyttelton's despatch, dated April 20th, 1905, and published in December of that year, coupled with Mr. Deakin's speech delivered at Melbourne in June last, has brought the question of the closer union of the Empire into the sphere of practical politics. The resolution recently adopted by the Chamber of Commerce of Liverpool (Feb. 5th; see page 496), Manchester (Feb. 23rd), and Leeds (Feb. 27th), proves that the great commercial centres are beginning to realise the practical value of the movement to business men. But before entering on my subject it would be well to give the authorities from which it is drawn. For the last three years or so a number of persons, many of them holding high positions, and many of them holding widely different views on political and economic questions, have been at work, under the chairmanship of Sir Frederick Pollock, elaborating a plan of Imperial organisation. Their work was summarised in a paper read by Sir Frederick before the Royal Colonial Institute in March of last year. Last summer it was decided that Sir F. Pollock, Mr. Pitt Kennedy, the honorary secretary, and myself should proceed to Canada with the object of learning the views of Canadians on the subject, and thither we accordingly went in the autumn. Our work was divided and the part specially undertaken by me was the branch of the inquiry referred to in the title of this paper, namely, the collection of information on the permanent objects of common utility to the whole Empire with which the new Imperial institution could successfully deal. The following paper is a brief summary of the results gleaned by me from the journey, from a correspondence conducted for a period of something like two years with leading men in Canada, Australasia, South Africa, India, and others of His Majesty's dominions beyond the seas, as well as from repeated journeys to the Colonies, and from official inquiries in former years.

Imperial organisation is no new term. It was in use, at any rate, as long as sixty years ago, and the idea underlying it, that of taking our colonies and dependencies into partnership on a business footing, has by its advantages and difficulties alternately attracted and repelled British statesmen for a far longer period. The history of the rise and fall of the various public and private movements which have had for their object the closer union of the Empire, and the best known of which is associated with the name, Imperial Federation—will prove not the least interesting of the tasks of the future historian of the Victorian era. The reason why one after another has failed, lies in the fact that there has indeed been a vague aspiration after Imperial unity; but no definite practical object of general utility to the whole Empire, no constitutional and administrative organ with which to work, and no great impulse to quicken the aspiration.

The impulse was given by the South African War, and the first result was the Imperial Defence Committee. There had been it is true, for some years, a Council with a similar title, but owing, amongst other reasons, to the want of a secretariat to keep a record of its proceedings, no practical result was obtained.

The committee over which Sir Frederick Pollock presided, came forward in October, 1904, with proposals which assumed a more definite form in March, 1905, advocating a similar secretariat, and an advisory Council to do for the civil affairs of the Empire, what the Committee, of which Sir George Clarke is secretary, is doing for naval and military questions, together with an Imperial Commission for special enquiries.

Mr. Lyttelton in his despatch, dated April 20th, 1905, adopted the proposals made by Sir Frederick Pollock's committee, though with some alterations. He suggested to the Colonial Governments that the Colonial Conferences should in future be termed an Imperial Council, that it should consist of the Premiers or other representatives of the Colonies who sent Ministers to the Conference of 1902, together with any Imperial or Colonial Minister whose advice may be required for special purposes, and that there should be a permanent secretariat. The Crown Colonies are apparently to be represented by the Secretary of State for the Colonies, who is to preside at the Conference, instead of the Premier, as suggested by Sir F. Pollock, and India is to be represented when necessary by the Secretary of State for India. In addition, there is to be an Imperial Commission distinct from the Council, to prepare subjects for discussion at the Conference, to investigate special problems referred to it by the Conference, and to inquire how ideas embodied in resolutions passed by the Conferences can best be carried out. This Commission would be employed to conduct enquiries, not only on matters referred to them by the Conference, but also in connection with the *ad hoc* Conferences, which have more than once taken place in recent years, upon a reference made to them by His Majesty's Government and one or more Colonial Governments. The Commission would consist of a permanent nucleus of members nominated in a certain proportion by His Majesty's Government, with power to obtain the appointment of additional members for special enquiries, and the remuneration, if any, of the Commissioners would rest with the Government appointing them. The Commission would have an office in London, and an adequate secretarial staff, at the expense of the Imperial Government. The secretary of the Commission would act as secretary of the Council when it met, and be responsible for the records of both the Council and the Commission.

It is beyond the scope of this paper to discuss the merits of Mr. Lyttelton's proposals, and how they vary from those of Sir Frederick Pollock's committee, but there is one great advantage we have gained from the despatch which should be recorded. There has been some dissatisfaction at the slender results of previous Colonial Conferences, and there was a growing danger lest the Conference should become more and more a pleasant outing for leading Colonial statesmen, and that less and less weight should be attached to these meetings in future. The despatch, which was on the whole well received by the Colonial Goverments, not only lifts the next Colonial Conference on to a new plane but provides the machinery for making the deliberation of future Conferences more effective. Whatever may be said of the other proposals, the permanent secretariat once appointed will show clearly to both permanent and political officials, as Sir George Clarke is said to have shown the great importance of things which are now being left undone. Mr. Walton, Treasurer of Cape Colony, wrote to me—"We all want a practical start." That is what we shall get from Mr. Lyttelton's despatch if it is acted on in time. Mr. Lyttelton's despatch was not published at home till December, and appears "to have been lost sight of" by the officials in Australia till July, but on June 14th, 1905, Mr. Deakin, who shortly afterwards became a second time Prime Minister of Australia, made a remarkable speech at Melbourne in which he adopted in all essentials the whole of the scheme put forward by Sir F. Pollock, and it should be added that others of our fellow subjects beyond the seas occupying positions scarcely less eminent, have expressed themselves quite as favourably.

In December, with the despatches was published an intimation that the Colonial Conference which was to have taken place in 1906 is to be postponed till 1907. We have, therefore, a short breathing time before the Conference meets, but there is a good deal of solid work to be done in the interval. We have to convince the Imperial Parliament, if necessary, that no encroachment is intended on its rights and privileges. We have to convince our colo-

nies and dependencies that no attack is intended on their existing or nascent autonomy, and, what is to my mind far more important, we have to convince the general public throughout the Empire of the value of the practical results which can be obtained from the new institutions. To me this has always appeared to be far the most important thing of all. Once we can convince the public here at home and beyond the seas of this, they will make short work of any difficulty, either about the form of the new council or the small sum necessary to defray the expenses of the secretariat and the new Commission.

From the business point of view the first and most important result that would be obtained would be uniformity of legislation and administration on all matters affecting the commercial community. At present, business men meet at Chambers of Commerce and Congresses of Chambers of Commerce, and pass resolutions on the subject: the resolutions are agreed to unanimously, they are forwarded to the proper quarter, namely, the department concerned, and there they are pigeon-holed. This has been going on now for twenty years and more. No further action is taken because it is not the business of any influential body to press such matters continually and energetically on the Government of the day which will always, if left to its own devices, occupy the time of Parliament with matters which attract more attention from the electorate. But there are, in fact, few questions of more real importance to the prosperity of the whole Empire, and those who know Germany well will agree that the uniformity achieved with endless trouble in the law affecting trade and its administration by the codes and the Supreme Court at Leipsic has been not the least important factor in building up, not only German industry and commerce, but also German unity. A brief enumeration of some of the questions concerned will show alike their gravity and the absurdity of the existing system.

To begin at the beginning, consider the law as to naturalisation. At the present moment there is a great influx, which I studied last autumn on the spot, of colonists from the United States into the North-West Province of Canada. In many cases, no doubt, the immigrants have been Canadians returning to their native land: but in the vast majority of cases now, these are aliens who are anxious to become naturalised, and who are taking out their naturalisation papers as fast as they can. Now the law as to naturalisation in Great Britain varies from that in the Colonies. The main difference in this instance is that in the United Kingdom a residence of five years is required, while in Canada a residence of only three years is required; but the result of the Imperial Statute is that a person naturalised is not a British citizen if he goes to London or Australia. The same is true of colonial naturalisation in New Zealand and elsewhere.

Then, again, in a community dependent above all others on the inventiveness of its citizens, it is a grave anomaly that to secure an invention throughout the King's dominions it is necessary to take out not one but at least twenty-eight patents, and, whereas a patent good for the whole of the United States costs £20, a patent good for the United Kingdom costs £100, and for the whole Empire from £500 to £600. In Canada a patent must be worked in two years, whereas in other parts of the Empire no such condition exists.

It is the same with the law affecting trade marks. We have indeed at last, in 1905, amended the law as to the registration and protection of trade marks, though the rules issued thereunder by the Board of Trade appear to require alteration. But the law in the United Kingdom and the law in British India are different, and the law in the West Indies is different again. Indeed, Barbados and Jamaica possess different regulations. What is wanted is an Imperial definition of a trade mark, a similar system of law and practice with regard to registration throughout the Empire, and some cheap and simple method of extending the protection of any mark registered in any one part of the Empire to the whole Empire. At present, to protect a trade mark throughout the Empire between 30 and 40 registrations must be effected, five in South Africa alone, and it is needless to add the process is always more or less costly. The recent amendment of the English law brings out more clearly the divergence of English from Colonial law, but on the other hand an attempt has been made in the Commonwealth of Australia to consolidate the existing law of the different States on the lines of the Act of 1905, a movement in the right direction which is worthy of record.

Then there is the question of copyright. The principal Imperial statute, that of 1842, which regulates the question and professes to legislate for the whole Empire, is generally admitted to be one of the worst penned on the Statute-book, and local legislatures (*e.g.*, that of Quebec) have compiled other statutes which are *ultra*

vires as well as badly drawn. The law in England is full of difficulties but the subject is one which does not interest Parliament, and although a comprehensive Bill has more than once passed the House of Lords it has not yet passed the House of Commons. At present with regard to the United States the Empire stands in this position. If an English author or publisher desires to secure copyright in the United States he must set up his book there. If an American desires the same protection in England he has only to send a few copies of his book to the Stationers'-hall and register it there, a manifest injustice to employers and workmen in the printing trade.

There are other matters of general interest to the whole Empire like the establishment of a uniform currency and a uniform system of weights and measures, reforms against which there are no valid arguments but the *vis inertiæ* of the Legislature. There are probably few if any business men who could pass an examination in the various systems of weights and measures prevalent in the Empire. Probably there are even in the United Kingdom some puzzles that well-informed men could not solve on the subject. As long ago as 1878 Germany adopted the metric system and made it compulsory, the United States is to make it compulsory in 1907, and then the British Empire will, with Russia, enjoy the proud distinction of standing in this respect outside the pale of civilisation. Yet as I write (March 8th) the Prime Minister has given an answer that he can make no promise for the framing this session of a Bill to make the metric system of weights and measures compulsory after the lapse of two years. Such a Bill, he said, if it became law would render illegal the use of all existing weights and measures, and he did not think there was any ground for anticipating that such a measure would be non-contentious.

These are some of the most important branches of commercial law about which it would not be difficult to secure uniformity. English legislation about partnership and bills of exchange has been widely adopted in the Colonies, and a commencement might be made with these. There are other branches like the law as to insolvency and marine insurance about which there would be rather more trouble, but which would still offer no such very serious obstacles. The law as to insolvency is one which presents great varieties. It not only varies in Great Britain and Canada, but in the Dominion itself the law is different on two banks of the same river. It is different at Hull from what it is at Ottawa. Business men will understand what that means in business.

The law as to marine insurance has first to be consolidated and simplified at home. The late Lord Herschell introduced an admirable Bill into the House of Lords in 1898. It has been introduced and passed by that House more than once since. In the present year it has been re-introduced by Lord Halsbury, and there is, I believe, practically no opposition to it. It is merely a matter of the Government taking it up.

The question of the consolidation and codification of our statutes has been a hobby of mine ever since 1884. Consolidation, as is well known, means the summarising of all the statutes on a given subject. Codification includes in the summary with the statutes the decisions given by the Judges on points arising out of the statute and the departmental orders which have the force of law. Formerly, as Professor von Gneist used to say, English legislation was a model to the Continent. Now, what with the habit of legislation by reference to previous statutes and the habit of leaving large and important gaps to be filled by departmental orders and Orders in Council, the confusion grows worse and worse every year. In 1885 I published a book on the German Criminal Code with the object of furthering the adoption of Sir James Stephen's Criminal Code, and then commenced a large book on the Commercial Codes of France, Germany, Italy, Spain, and Russia, with a view to the codification of our commercial law, in which the late Lord Hannen gave me much valuable advice. But when it became clear that the Conservative Government of the day, which had included a Criminal Code in its programme, had dropped it for want of parliamentary driving power, I gave up the idea though the book was partly in print, recognising that such books were of no immediate practical use to bring about the desired reform as they are not read by members of Parliament. The work, however, taught me that foreign Governments had overcome far greater difficulties than lie in our path, that the codes once enacted are a substantial benefit to the business community, and that in the case of a country like Germany they have exercised a definitely unifying force. In the course of repeated and prolonged visits to the Colonies this conviction grew on me, and as I became familiar with the work of Sir Samuel Griffith,

G.C.M.G., now Chief Justice of Australia, in the Queensland Criminal Code and Criminal Practice Rules which form a code of Criminal Procedure, my desire increased to see such work imitated here. The close, some years ago, of the Government second edition of the revised statutes with 1886, made me think of a formal appeal to the Government. I asked questions, and spoke in the House of Commons, and outside. I wrote to *The Times* again and again, but nothing came of it. The Government were polite, but unfavourable. Consolidation stopped suddenly about 1897. The Friendly Societies Act of 1896 was our last consolidating Act, with the exception of the Factory Act, 1901, in consequence of the objections raised to a Post-office Consolidation Bill for introducing too many amendments. Of course, amendment should precede consolidation, and not be mixed up with it. There is no doubt the subject from its nature is not popular, and for a long time there has seemed to be no hope whatever of progress in this direction, but hope has come and may be realised with the new Parliament, and the new spirit which is abroad, once we get the new system of Imperial organisation at work. A straw shows which way the wind blows. It was my duty the other day, as President of the Central Poor-law Conference, to bring the question of the codification of the Poor-law before the President of the Local Government Board, and I received instead of the usual polite *non possumus*, for the first time in ten years, an encouraging official reply. Now there is no comparison between the difficulties of codifying the Poor-law and the Commercial Law. The Poor-law is infinitely more complicated, and infinitely more debateable.

The procedure in regard to commercial law would be simple. The question, for instance, of codifying the Patent Law would be submitted by the Imperial Council to the Imperial Commission, which would be strengthened, if necessary, by additional experts. They would draft a code which might be passed as non-contentious by the Imperial Parliament and such of the Colonial Parliaments as wished to do so, and this one may venture to prophesy would be all Colonial Parliaments.

Or Parliament might in the first instance be induced, with the driving power behind the present Government, to pass compendious intelligible resolutions and to commit their execution to the Imperial Council and the Imperial Commission, on the request of the Imperial Council. But nothing short of a recommendation from such a body would, I fear, induce the House of Commons to abandon so much of a power of which it has made in recent years so faulty and so inadequate a use. The Society of Comparative Legislation has done much admirable pioneer work in this direction, and Sir Frederick Pollock's partnership code is well known. Edward I. has been called the English Justinian. That title may still be realised for Edward VII., not only in the United Kingdom but also in the Britains beyonds the seas. But here as in other departments the value of system and method must be recognised.

There are several minor grievances suffered by commercial men from local legislation both in the colonies and at home. For instance the local legislature in the province of Quebec imposes a burdensome tax on commercial travellers. Similar legislation exists in Prince Edward Island, in British Columbia, and in all the South African colonies. There are other matters like the light dues, so often discussed not only by meetings of Chambers of Commerce but also by the Imperial Parliament, in which some of the partner States have a substantial grievance against the Home Government. As is well known it is claimed by British shipowners that the duty of lighting and marking the coast is a high Imperial duty of the Government and one performed by all great powers except Great Britain and Turkey at the public expense. It is claimed that the light dues are not only an unfair burden on the shipping industry but also put it at a disadvantage in foreign countries. Canada has a special grievance, because Canada maintains a free light service and yet Canadian ships are charged light dues in the United States because of the legislation of the Imperial Government. There is in addition the whole series of labour and social enactments, the codification and consolidation of which would be of great advantage to both employers and employed throughout the Empire. All classes would gain by an attempt to bring the conditions of labour in the backward parts of the Empire to the same level as the foremost, just as all classes would gain by the promotion, through legislation, of a system of voluntary arbitration and conciliation. The work, then, which can be usefully done in the field of legislation in the direction of the unity of the Empire is enormous, but the work which could be done in the field of administration is equally large.

Take the question of a Supreme Court of Appeal for the whole Empire. Successful

administrators like Sir Cecil Clementi Smith, G.C.M.G., formerly Governor of the Straits Settlements, and Sir Frederick Fryer, K.C.S.I., formerly Lieutenant-Governor of Burma, join with great lawyers like Sir Samuel Griffith, G.C.M.G., the Chief Justice of Australia, and great Colonial statesmen like Sir John Forrest, G.C.M.G., Treasurer of Australia, in advocating such a Court as "a great addition to the visible dignity and substantial unity of the Empire." One need not refer again to the part played in the unity of the German Empire by the Supreme Court of the Empire at Leipsig. It was daily brought home to me when I was studying these questions at German Universities. New Zealanders are not all in agreement as to the value of such a Court, but Mr. Justice Williams, writing on Jan. 23rd, 1905, said :—

"On the importance of the establishment of a single Final Court of Appeal I quite agree. I differ altogether from those who advocate the abolition or extinction of the right of appeal from the Colonies to Great Britain. But if the right of appeal is to be preserved, endeavour must be directed to make the Final Court of Appeal in every sense the most efficient Court in the world."

Writing again on January 15th, 1906, in a letter just received, he observes :—

"I do not think it is generally known that the best plan for an Imperial Final Court of Appeal was drawn up by Lord Westbury as long ago as 1859. . . . . . What is wanted is a much more numerous court than the Privy Council, with Divisions, each of which would deal with some particular legal system. Members of the Court might sit in any Division, but in each Division there should be one or more members who have made a special study of the system with which the Division has to deal. At present the four or five members of the Privy Council are supposed to be omniscient in about half-a-dozen legal systems. Last time I was in England I looked in at the Privy Council. It was an Indian appeal. I listened. The case appeared to me to be this. If a certain man had begotten a son under certain conditions, he had obtained for his grandfather everlasting felicity. If he had obtained for his grandfather everlasting felicity certain property went one way. If he had not it went another. I felt I could be of no assistance as *amicus curiæ* and went away. But the proverb, 'Qui trop embrasse mal étreint,' did occur to me."

Apart from the administration of justice there are many points in which the Departments at home overlap, to the great detriment of the public service. Those who are familiar with some recent negotiations in which the Foreign Office and Colonial Office have been engaged will be ready to testify to the overlapping then. Indeed a competent authority writes that :—

"Imperial problems outranging the scope of any one particular Government office are not confined to the Colonial sphere. They arise on all sides. Under existing circumstances such problems may theoretically be dealt with either by correspondence between departments, an admittedly slow, clumsy, and otherwise unsatisfactory procedure, or by reference to the Prime Minister and the Cabinet."

In practice this probably goes as a rule to the Cabinet, where discussion and explanation takes place after the circulation of papers by the several Ministers whose departments are concerned. It is easy to see how much would be gained if such matters had already been discussed from a higher Imperial standpoint at an Imperial Council.

Leaving overlapping on one side, there is still a great deal to be done in reforming the methods by which information of value to business men is collected and disseminated. The British Empire census, published on March 9th, 1906, is a step in the right direction. It brings home to all concerned not only elementary facts such as those that the British Empire embraces some 400 millions of people and more than one-fifth of the surface of the globe, but information concerning the density of the population, and the occupation of the people, &c., which was difficult of access if not inaccessible. But there is still an immense amount to be done in the way of organisation of information. A Committee of the British Association pointed out in a report published last autumn (1) the desirability of a common statistical method within the British Empire, and the interchange of views with the object of reaching a common method of classification, estimation of value and record of the origin and destination of goods; (2) the desirability of publishing an annual report on the trade of the Empire on a scale sufficiently large to present in considerable detail the trade of the King's dominions beyond the seas; (3) the desirability of extending the uniformity attained in Australia by the publication of the year-book of the trade of the Australian Commonwealth, and in Canada by the statistical year book of Canada, and the report of the Canadian Department of Trade and Commerce. There is at present no year book on the trade of the South African Customs Union, and in the West Indies there is need of closer customs relations, and the issue of a joint annual report. A common system should obtain in India, the Straits

Settlements and the other Asiatic possessions of Great Britain. It should be added that the information as to the Crown Colonies is very deficient and lacking in uniformity; (4) the importance of a prefatory note being prefixed to the statistical scheme of each colony, explaining the system of valuation, of registration of origin and destination, inclusive and exclusive of transhipment and transit trade, bullion and specie, bunker coal, &c., and affording other comments to assist the proper interpretation of statistics; (5) the importance that both for obtaining a more reliable criterion of trade and production of each colony, and for the establishment of satisfactory comparisons as to the productive power of the several States of the Empire, import and export statistics should be supplemented by a system of figures showing the internal trade and production of each colony; (6) the importance of establishing a common statistical year.

It is in fact open to doubt whether we have yet got adequate facts or figures to decide on, at any rate, some of the issues raised by the fiscal question. Imperial organisation may be the means of getting for us some of this most important intelligence. Sir Frederick Pollock's committee contains eminent Free Traders as well as eminent Protectionists, and therefore can emit no opinion as to Mr. Chamberlain's proposals, but it is quite safe to say that accurate imformation will be welcomed by all. The present system can only be described as chaos.

Another sphere into which method will have to be introduced is the consular service, which is said to be receiving the consideration of His Majesty's Government. But the consular service will not only require reorganisation, it will have to be extended in some shape or way to the Colonies.

Personally, consular officers have made a most favourable impression on me when I have been collecting information from them for the Labour Commission or for use in the House of Commons, or for scientific work. It is now nearly a quarter of a century since I first came into practical contact with their work, and in that period, with the exception of the South American republics, there is hardly an important consular district with which I have not been brought into touch directly in travelling or indirectly by a study of their reports. It is therefore a pleasure and a duty to state that they have almost without exception appeared to me to be not only courteous but also competent public servants. At the same time, there is no doubt that they do not always impress the average business man so favorably. It is probable that the central Government is much to blame. The Board of Trade, the Foreign Office, and the Commercial Intelligence Department overlap, and it entirely depends which of these departments possesses at a given moment the most competent and energetic officers as to which does or tries to do the work. It would be invidious to say how this stands at the present time, but it is quite obvious that something is wrong, and not only at head-quarters. The consuls themselves have often diplomatic as well as consular duties to perform, and are often not clear as to which duties have the first call on their time. Often, too, they are asked to make bricks without straw, often to do the work of ten men without any assistance, clerical or otherwise. In addition to this, in spite of the recommendations of committees and the supervision of the Imperial Parliament, the best posts in the consular service are still sometimes given to outsiders who are not only not in touch with the trading centres in England and the Colonies and their needs, but are apt, according to the traders to look down on the trade which it is their duty to guard and foster. Consular officers who are to serve in China, for instance, should be obliged to spend some time at the centre of the cotton industry, and obtain a thorough knowledge of what they can do to help the merchants employed in it. A perfunctory visit is worse than useless. It raises friction and irritation, to my certain knowledge, which it takes some time to allay.

Furthermore, consuls are sometimes not British subjects, but Americans or Germans likely to favour their own countrymen.

Something analagous to the consular service should also be established in the Colonies. At the present moment there is in Canada, not a single official appointed by the British Government to report upon commercial matters for the benefit of the British exporter, while there are no less than 189 consular and trade agents of various ranks, appointed by the United States Government, scattered through Canada, reporting to Washington regularly on every conceivable topic of commercial information. These reports are promptly printed in the United States Daily Consular and Trade Reports, and distributed by mail free (by thousands) in every State of the Union. The Canadian market

is laid bare to the American exporter. Every opportunity is made known to him. Should the United States exporter desire further information upon any commercial matter, anywhere in Canada, he has some one on the spot, to whom he can write, paid to do his bidding.

"Compared with all this," writes Mr. O'Hara, of the Canadian Ministry of Commerce, in a letter to *The Times*, printed on Dec. 29th, 1905, "what assistance has Great Britain to offer her exporters in Canada? Absolutely, none." Other foreign countries, besides the United States, have representatives in Canada. Germany has 16, France 15, Brazil 14, Belgium, Italy, Portugal, and Spain 10 each, Norway and Sweden together 33.

It has been said, that there is the Canadian Ministry of Commerce; why don't they help, why does not the High Commissioner in London help? The answer is that these officials exist to promote Canadian exports, not Canadian imports, and for the same purpose the Canadian Government maintains agents not only in Great Britain, but also in Australasia, France, Norway, Sweden, South Africa, and the United States, whose reports it publishes as soon as they come in and circulates them broadcast. Perhaps the thing that struck me most when I visited the Canadian Ministry of Commerce last autumn was the systematic manner in which it tries to put Canadians, anxious to do business with foreigners, in touch with them, and *vice-versá*. Quasi-consular officers if maintained in Canada would place the British exporter on a better footing with his rivals not only in private trade, but also in the matter of public contracts which now go almost always to the United States. Even if it is replied that the British exporter has his hands full, such information would enable him to pick and choose and do more lucrative instead of less lucrative business. It must be recollected that such reports are not so much required for the big firms who are able to send representatives to see Canada for themselves, as to make a ladder for the struggling small employer who cannot afford such expense. While on this subject I should like to say that as far as these many years of travel and contact with British business men enable one to form an opinion, it is not only idle, but wrong to talk of the decadence of British commercial ability. The British merchant has, as a rule, all the energy and ability of his rivals, and, as a rule, he is straighter and inspires more confidence. People would rather do business with him. He has no doubt a harder struggle than formerly, but I have often heard even in remote places like Siberia, that the outcry in the British press about the decadence of British trade is not only unfounded, but it does positive harm. People like to trade with a going concern.

There is another matter in which method is required, and that is the interchange of Colonial officials at home and in the Colonies. The Foreign Office interchanges its clerks more or less systematically with the secretaries in the diplomatic service; business men who can afford it do this systematically, with their branches in foreign countries and the colonies. Even the Church is alive to the importance of the matter, and I met at Kalgourlie, in West Australia, young clergymen who were interchanging duties as part of a general scheme. But in the Colonial Office there is no such plan, though occasionally a high official gets a governorship. This is a matter requiring immediate attention. Every opportunity should be taken of bringing young clerks in personal contact with the Colonies of their section. They should be sent out as private secretaries to the Governors, if no other way of interchange can be devised. To Mr. Lyttelton is due at any rate the plan of bringing home the head officials, for instance, in Nigeria, for a period of work at home. But the principle requires systematic extension. For instance, it is I believe the fact that an attempt has been made to cope with the difficulties of land settlements in Uganda with inexperienced men, when over the water in India there are some of the best experts in the world. Organisation is required to bring the Empire together in matters of administration.

This brings me to the organisation of communications. There is no doubt to my mind that cheap postal and telegraphic services will do more for the unification of the Empire than any other single thing. Cheap telegrams will ensure that in every morning paper in our colonies and dependencies there will be full accounts of the topics which are interesting people at home, and *vice-versâ*. As to telegrams, there are at this moment many anomalies. For instance, a cable to Havana costs 1s. 6d. a word, to Trinidad 5s. 1d. a word, and to Demerara 7s. a word.

Cheap postal rates for letters mean the maintenance of regular communication between colonists, however poor, and their people at home. Cheap postal rates for newspapers

and periodicals mean the introduction, for instance into Canada of English journals and reviews which cannot now compete with American periodicals. Reviews and periodicals cost 1 cent per lb. from the United States to Canada, and 8 cents from Great Britain to Canada, a rate which is almost prohibitive. It is I am well aware a matter of revenue, but it is one which will have to be considered whatever burden it may impose on the Imperial Exchequer. At present loud complaints are made from one end of the Dominion to another that owing to the rates charged by the Imperial Post-office the Canadian public is only able to see current questions through American spectacles, and that the few English magazines that reach Canada are filled to the annoyance of Canadian business men with American and not English advertisements.

There is further the question of sea communication for passengers and goods between the different portions of the Empire. It must never be forgotten what the sea is to the British Empire. It is the one means of communication between the partner States. Cheap passenger rates means regular visits home and constant personal touch with the old country, a thing formerly unknown but possible even from Australia and New Zealand for even the relatively poor. That at any rate was I recollect one of the late Mr. Ismay's objects when he put 60,000 tons of new shipping into that trade. He always took a statesmanlike view of his work.

Apart from passenger rates there is the question of the rates for goods. At the present time owing to German and American competition, shipping rings and other causes into which it is unnecessary to enter, the rates on goods sent from Hamburg and New York to South Africa, Australia, and New Zealand are, roughly speaking, half what they are from London or Liverpool, and the New York goods come *viâ* Liverpool. Canada is trying to set up independent communication with South Africa, and there have been attempts to do the same between Australia and South Africa. This is a question for careful inquiry. Here we find ourselves face to face with the question of foreign subsidies, and one may quote that most able, experienced official and inveterate free trader, Sir Robert Giffen, who gave evidence before the Select Committee on Shipping Subsidies. There is a good case, he held, for subsidising steamers for carrying on a direct trade between the United Kingdom and East Africa, and between South Africa and Australia. The Government must see that the ships are really British ships, and that they carry goods as cheaply between this country and their destination as they do between Continental ports and the same place. The question of speed Sir Robert considers of importance, so as to bring the different parts of the Empire together, and to give the Government a sufficient command of swift steamers. He would also exclude altogether foreign ships, and especially foreign subsidised ships, from the coasting trade of the different parts of the British Empire, and from the interprovincial trade, *e.g.*, between the United Kingdom and India or India and Australia. This is already the policy of the United States and the Empire of Russia; or he would admit such ships to the trade only on condition of their complying with the same rule as to construction, equipment, and inspection as English ships, paying the same taxes, and paying a fine for the privilege equal to and exceeding any subsidy they may receive. In any case, no such ships should be admitted to the privilege whose crews, directly or indirectly, form part of a foreign navy or its reserve, or when the ships are liable to be incorporated with such navy in time of war. Sir Robert Giffen feels so strongly on the matter that, in order to prevent British ships being driven out of a trade by subsidised competition, he goes so far as to say:—"If the matter should become serious enough, the Government ought not to shrink from a last step, that is to run ships on certain lines to bring goods for nothing to English ports—no freight at all—so as to extinguish by making unprofitable the unfair competition." He proposes, in fact, to re-enact the navigation laws, in favour of which, by the way, Adam Smith himself made an exception. It is not altogether an economic question. "What we have to face is really a hostile attack on a vital industry of this country in time of peace, carried on directly or indirectly, not by ordinary competitors but by foreign Governments." In such a matter what is required is concerted deliberation, and, if necessary, concerted action on the part of the whole Empire.

Mention should be made in passing of the influence the new Council, or permanent Conference, would bring to bear on some branches of this question in Crown Colonies. It will not be possible for an important matter like that of railways in Nigeria to be discussed, as a recent Blue-book shows they have been for fourteen years with no result.

To return to the shipping question, there is another branch which requires special attention, and that is the training of seamen. The British seaman is disappearing from British merchant ships. There are at present something like 40,000 foreigners earning about two millions sterling annually on British ships. With all the talk there has been of primary, secondary, and technical education, there has been no systematic attempt to devise a ladder by which the British seaman may rise in his profession, and no conception of an Imperial organisation of the training of British seamen. There is abundance of good material, for instance, in the maritime provinces of Canada and elsewhere, but it is no one's business to tackle the question from the Imperial point of view. As the chairman of an English training ship which has put 3,000 boys into the navy, and more than 3,000 into the mercantile marine, I have had to deal with some parts of of the problem for several years past. The apathy of statesmen and the general public is simply appalling. Looked at merely as a matter of a naval reserve, in other words, as fire insurance, the position is most serious. In this question of the natural reserve it is believed that the Canadian Government is prepared to meet the British Cabinet at least half way.

In conclusion, it is necessary to touch, however briefly, on some questions of high Imperial policy for which Imperial organisation is urgently required.

Apart from the actual meetings of the Imperial Council, to use the words of Sir Samuel Griffith, "One great advantage would follow, that the individual member would be able, without incurring the blame of impertinent intrusion, to make communications which might be of great value on points which under the present system only come to the knowledge of the Government by accident, if at all. My own experience suggests many such instances."

Apart from the receipt of information, the co-ordination of information when received would be of the utmost value. There are two cases in point in recent colonial policy. No one in Canada now defends the extreme Canadian claims with regard to Alaska, but at the time of the arbitration feeling ran high against the old country for not supporting them. If there had been in existence an Imperial Council before which the claims could have been discussed, the other Colonial representatives would probably have sided with the Imperial Government and Canadians would have understood that it was not merely from want of sympathy and want of intelligence and backbone at home that their claims were not upheld. At this moment there is a similar case, namely, the claims of Australia with regard to the New Hebrides. The cablegrams of March 7th show that both Australians and New Zealanders complain that they have not been consulted with regard to the Anglo-French agreement. The fact that the agreement is now to be submitted to them does not seem to mollify them.

But in addition to such problems for which there are many parallels in the past and in recent Colonial history, there are many problems arising like the relation of Canada and the West Indies, of an entirely novel character, and which require a new authority to deal with them. A movement is on foot for a closer union between the Dominion and the islands of the West Indies and British Guiana. It is recognised, both in the Dominion and in the West Indies, that Canada has as great a future before her as the United States. The latter are now acquiring tropical possessions to supply their people with the tropical products which now enter so largely into their daily diet. Canada, it is thought, must obtain a tropical annexe in order to safe-guard her own position and complete her existence as a nation. But a union of these two Colonial systems is a matter in which the whole Empire is interested from a naval and military as well as from a commercial point of view. No Imperial Cabinet, whether Conservative or Liberal, would undertake to consider such a plan without consulting all the States and parties interested. There is at present no Committee or Council which could give adequate consideration to such a problem. The proposed annexation by New Zealand of Fiji and the relations of Newfoundland to Canada involve similar matters of principle.

There are other questions like the relation of Canada with Australia which, from time to time, give cause for anxiety from their want of cordiality. It may have been a small matter, but the publication last autumn of a Blue-book in West Australia which was thought to be unfriendly in tone to Canada, caused quite a breeze in the Dominion Press. This and other subjects such as the one arising in connection with the line of steamers between Canada and Australia show the need of a Council, I will not say a tribunal, before which such matters can be calmly and systematically discussed on neutral ground, on the basis of a careful col-

lection of all the necessary facts, and not as a matter of uninformed comment, more or less dignified by the Press of the countries concerned.

The Empire stands in need not only of the collection but also of the dissemination of authoritative information on Imperial questions. In England we have a leisured class which by education as well as tradition and a sense of duty, look to public affairs as the proper outlet for its energies. Such a class generally gives time and labour to the acquisition of the necessary information. In the King's dominions beyond the sea such men are rare, and even in Parliament at home we have an ever-increasing number of persons who have not enjoyed the opportunities of study and travel. Now on questions like the relations of the Empire with Russia, it is most desirable that leaders of public opinion in the Colonies should be in possession of the outline of the policy which it is proposed to follow. These might be subjects for confidential communication, but there are other matters about which information is desirable for a wider circle. Our interests conflict with those of Russia, not only in the East and middle East, where they are under the ægis of the new Anglo-Japanese Treaty, but also in the near East and the north of Europe. We have in each case guaranteed the integrity of territory on which Russia has in time past, and will again in future, cast a longing eye. It is not too much to say that the Colonial public has no idea of these guarantees or the responsibility they may entail.

Last, but not least, it is much to be hoped that sudden changes in foreign and colonial policy resulting from changes of Government may become things of the past. But there is no doubt that the existence of an Imperial Council would tend to a continuity of policy which is in every way desirable. One does not wish to raise any controversial topic such as those connected with either Egypt or South Africa, but one may safely say that the maintenance of our commercial rights under treaties for instance in China would be an important item under this head. Now the interests of Great Britain in China are enormous. In 1904 the registered tons of British shipping entering and clearing in China ports was a little below 33,000,000 tons, 51 per cent. of the whole. If you add the Anglo-Chinese shipping it is 75 per cent. England's share of the foreign trade of China is 346,000,000 taels, or 56·80 per cent., and 50·45 of the coast trade. Out of 18,000 Europeans in China 6,000 are British subjects. Every one of the difficulties in the Far East in recent years can be traced not indirectly but directly to the vacillation of British policy. Thanks to Sir James Mackay we made an excellent treaty with China in September, 1902, but that treaty has been almost ignored. I will mention only two articles the execution of which is of the utmost importance to the vast interests of Britain in China: article 8 as to the abolition of likin, and article 2 as to the establishment of a national coinage. There are other provisions to mines and railways which will require constant attention. When one thinks of the importance of the China trade to Lancashire alone, apart from the position of Hongkong, now within a measurable distance of becoming the first port of the Empire, one sees that here is a question as to which both from Imperial and a domestic point of view continuity of policy requires to be pressed upon the attention of the Government by an Imperial authority. But there are not only questions of vast importance to the Empire in which commercial rights have to be studiously supported, there are smaller colonial interests like those of Trinidad as against Venezuela. Venezuela has for the last quarter of a century persistently, in violation of the treaty of 1825, boycotted Trinidad, which has appealed to the Colonial Office again and again in vain. A body on which the partner States are adequately represented will not lose sight of a question of this kind.

A review of these considerations has induced the Liverpool Chamber of Commerce to pass a resolution in favour of an Imperial Advisory Council and an Intelligence Department for the civil affairs of the Empire. That resolution has been placed on the agenda of the Congress of Chamber of Commerce of the Empire which is to be held in London in July, and similar resolutions have been passed by the Chambers of Commerce at Manchester and Leeds. The business men are therefore awaking up to the advantages they may obtain from Imperial organisation, and one is very grateful for the opportunity of bringing the question before this Society which numbers in its ranks so many distinguished and practical men in every department of English life.

The very fact that the matter has been discussed here gives one grounds for the hope that the time is not far distant when Colonial policy may be raised above the sphere of party politics. Foreign policy and naval policy are

no longer party questions. Mr. Haldane, by his great speech last week, has placed military policy on the same pedestal. Why not Colonial policy too? Nay more. It is compatible with the deepest appreciation of the sterling work done in recent years at the Colonial Office resulting in an increase of sympathy with the Colonies, and an increase of efficiency all round, to say that we want in our Colonial policy more of the new spirit which breathes in Mr. Haldane's speech, the spirit which requires more hard thinking, more method and more system. It has been the object of this paper to show that the proposed Imperial organisation will be a step in this direction, and that it is in every way desirable from a business point of view.

Appendix.

The Liverpool Resolution.

Resolved that, in the opinion of this Chamber, it is desirable that His Majesty's Government should establish an Imperial Advisory Council, with a Department of Intelligence for the civil affairs of the Empire. The work of such an organisation would, in the opinion of this Chamber, lead to that more desirable uniformity in the administration and commercial legislation of the Empire which this Chamber has long consistently advocated, as, for instance, in the laws relating to patents, currency, weights and measures, trade marks, bills of exchange, partnership, marine insurance, copyright, &c., and would further be a medium for the collection and dissemination of valuable information on matters of high Imperial policy, and tend to a closer union of the Empire.

DISCUSSION.

The Chairman, in opening the discussion, said that it would be profitable to consider exactly at what stage they had arrived in the question under discussion. He wished, in the first place, to acknowledge the great services which had been rendered by Sir Frederick Pollock's committee, and especially by Sir Frederick himself in organising that committee and being its mouthpiece in the public journals, and in organising efforts which had produced, as usual, a controversy of some kind, but which at any rate had had the positive benefit of stirring up the Colonial Office. It was, perhaps, vain to expect that the contents of a Blue-book would be read by more than a few individuals, and there was very great danger of anything which was framed in that somewhat dismal surrounding being lost sight of, as his despatch was for a time by the Australian Government. It was therefore, perhaps, worth while to remind the audience what the Colonial Office decision was with reference to the matter so far back as April, 1905. He had noticed that the Colonial Conferences which had taken place in 1887, 1897, and in 1902, had been summoned upon occasions of national festivity, and in the middle of the summer in London. There were people who could work their very best in very hot climates, notwithstanding the failing condition of those around them; but when a very important gathering took place in London in July or August of Colonial Premiers coming from thousands of miles, he thought they might feel that that was not, without great preparation beforehand, altogether an opportune moment for the settlement of important business matters. The Colonial Prime Ministers might come at any time of the year, and would be welcome, even in July or August, but the preparation for the meeting should be thorough, so that the ground might be completely scouted before they arrived. People had omitted to recognise that that was done, so far as possible at any rate, before the last Conference, by the Colonial Office itself. Months and months of labour were spent by the Colonial Office in preparing the subjects; but there was the difference between the Imperial Government and the Colonial Governments in such matters, that the latter had not the opportunity or the men who had time to spare for the preparation of the subjects before they came. The great difficulty in all the Colonies was to get numbers of men of sufficient leisure to be able to attend to public affairs at all, and those who did attend were very much engrossed with the business of their own country, in connection with which they had not the enormous assistance of the permanent departments which assisted English Ministers, and were such a support and guide to them. Now that Conferences were to be summoned every four years, they became definitely systematised and periodicity was established; that seemed to be the first step to be taken, and that was established in 1902. The next step which seemed to him desirable was that preparation should be made before those Conferences took place, extending if possible over some years, before the Conference took place. The question was, how that preparation was to be organised. Very delicate and sensitive questions had to be considered in reference to the matter. There was not only the sensitiveness of the House of Commons, which was perhaps more easily handled than some other bodies in that matter, but also the natural sensitiveness of the Colonies with regard to their own autonomy. They desired to make it perfectly clear at the outset that no interference was to be made, either with the supreme authority of the British Parliament or with the autonomy of the self-governing colonies, and their object therefore was, if possible, to secure that good men should sit permanently before the Colonial Conferences took place, although not merely in an advisory position. In that connection they wished to draw upon the great reserves of ability that were

in the country. Everybody was conscious that very often the most able men did not, perhaps owing to good fortune, rise to positions of so-called eminence; they escaped much undeserved censure, and also much platitudinous praise; but there was an immense body of private ability not engaged in official work which could be obtained if those individuals who possessed it could be persuaded that the subjects to which they had devoted their labour were of great importance, and that by their efforts important movements in national history could be made. He hoped that on the Commission which he referred to in his despatch —and which he hoped would be established—there would be not only representatives of the Colonial Office, the Board of Trade, the Foreign Office, and the India Office, but that the Secretary upon whom much would fall would be able to summon to the assistance of the Commission various persons known to be, though perhaps only in a quiet way, great experts upon the subjects on which they had been engaged, besides men of greater notoriety who had made a name in public affairs. He did not believe there would be very much difficulty in getting together such a Permanent Committee which might devote itself to the labours which had been indicated by Mr. Drage; but would it be possible to get recommendations of such a committee accepted by, and made acceptable to, the Colonies? He imagined there would be a difficulty in that, unless Colonial representatives were obtained to sit on the Commission. If Colonial representatives could be obtained, naturally information of the most important kind would be obtained, which even the most skillful and experienced person in this country could hardly otherwise have access to. But it was no good blinking at the fact that it was difficult to get such men from the Colonies. The Colonies had not many such men to spare, and they were sensitive about being represented by anyone to whom anything like a free hand was given. Constant reference home had to be made by the distinguished colonists who sat on such committees in England, and the machine thus moved with a good deal of slowness and a certain amount of friction. It was no good blinding themselves to such matters; they were almost inevitable, but he did not think that need deter them for a moment from pursuing the course which had, on the whole, been received so well. He imagined that, at anyrate, certain distinguished colonists would be able to sit on these committees, and he felt sure that if the Commission digested the information they had obtained, placed it in a good summarised form, and made it accessible to the Colonial and British Ministers before the Colonial Conference took place, then those Colonial Conferences must necessarily be of a more business-like character than they had hitherto been. It was impossible that men, weighted with such vast cares as those who had met hitherto at the Colonial Conferences, could, without a good deal of assistance, push forward many matters, but they might agree upon many questions in principle, and then devolve the working out of the details to a Commission, which had the secretariat mentioned in the paper, which secretariat might have the power to summon able men to deal with the question hereafter. Mr. Drage had stated that the Defence Committee was analogous to the committee he proposed, but it must be remembered that the Defence Committee had not hitherto, except upon one occasion, had the advantage of any assistance from the Colonies. A very important start was made by calling Sir Frederick Borden, the War Minister in Canada, to take part as a member of the Defence Committee; but, as a rule, the Defence Committee consisted of the Prime Minister and representatives from the Admiralty, the War Office, the Treasury, and sometimes the Colonial Office; so that people with the material were always at hand who could be rapidly summoned, and thus, in the main, consisted of British officials. The Prime Minister possessed the power to summon anybody he thought fit, but, with the exception of the occasion he had referred to, he could not recall any instance in which that power had been exercised. Therefore the suggestion which had been made, although erected to some extent on the analogy of the Defence Committee, was not at all a complete analogy. They hoped to get rather more outside assistance for the Commission in order to prepare the work for the Colonial Conference, and, on the whole, perhaps make it somewhat less official than the Imperial Defence Committee. He would like Sir Frederick Pollock to develop his views upon the points on which his (the Chairman's) despatch to the Colonies fell short of what he desired. He fully recognised the value of Mr. Drage's suggestion with regard to the interchange of officials at the Colonial Office, and rather more had been done in that connection than the author seemed to be aware of. He tried himself to leave a system, which he hoped would soon be put into power, by which the West African officials had an opportunity of coming home for, say, six months at a time; and an experiment was made in that direction in the case of Sir Frederick Lugard, who takes a place in the Colonial Office, carrying on the Governorship from the Colonial Office, so as to preserve that continuity which, as in the case of Lord Cromer and Egypt, had produced such wonderfully good results. He was entirely in agreement with what the author said as to the improvements that were necessary in communication. He had received bitter complaints from Lord Grey that important speeches made in Canada were hardly reported in the British press, and it was certainly true that very important speeches made in England with reference to Canadian affairs, and which would be of the greatest possible interest to public opinion in Canada, did not obtain any currency at all in that country. The Government and officials in England could only communicate with the Government and officials in Canada, but it was of immense

importance that public opinion in Canada should also be approached and informed, in order that opinion when aroused, might react on the Canadian Government.

Sir FREDERICK POLLOCK, Bart., said the object of the work which he had undertaken was from the first to bring together the people who had been thinking seriously about the subject under discussion, and to find out how much they were agreed upon fundamental points. A start was made with a group of from a dozen to twenty people, which gradually increased to forty or fifty, who, at the outset, appeared to hold very widely divergent notions as to the way in which Imperial business could be organised. The subjects were gradually thrashed out in a way which could not have been possible in the discussions of any regularly formed society; it was found that tendencies to agreement existed, and in course of time they were pretty much agreed upon the substantial points, and Mr. Lyttelton, then Colonial Secretary, sent out last April a despatch which embodied very similar ideas. The replies which were received were, on the whole favourable, though some were more cordial than others. The only answer received which could be called a dissenting one came from Newfoundland, and that was apparently based on a considerable misunderstanding of the whole scope of the proposals made. The objection which had several times been made to all proposals of organising any kind of permanent Imperial Council was, What would such a Council do? The answer to that question had been supplied in the most practical form by the author. The difficulty was not to find the work but to find the people with the time to do it. Mr. Drage had a list of at least a dozen subjects of Imperial interest, very few of them connected with any contentious topic (such as ambitious military plans), some of them declared to be urgent by the highest authorities, and none of them as yet put in any way of being effectually dealt with; and in almost every case the failure could be attributed to the want of cooperation and adequate communication between the different Governments and departments concerned. After considering the facts brought forward in the paper, he did not think anybody could say there was not a good deal of Imperial business which was not done, but which ought to be done, and for the doing of which it was not beyond the wit of man to contrive adequate machinery. He did not know whether anybody present had any hankerings after such schemes of Imperial federation, as were put forward with the best intentions about 12 or 15 years ago—schemes involving the framing of a formal constitution of the British Empire, and the passing of ambitious Acts of Parliament, not only in England but in the Legislatures of all the self-governing colonies; he desired to state positively that any such scheme was out of the question, for the simple reason that the Colonies would not have anything of the kind at any price. Although there were a certain number of enthusiasts in Canada who would still like a Constitution for the British Empire, the overwhelming majority of Canadian opinion was dead against it, so that it was quite useless considering the speculative merits of any such scheme at present. He did not know about Australia of his own knowledge, but he had no reason to doubt that the feelings of Australia and New Zealand were the same. Moreover it was very important, if anything practicable was to be done, to get it done with as little legislation as possible. Therefore the first objects of the body of gentlemen whom he represented was to see how much could be done without an Act of Parliament. There was absolutely nothing in the scheme set forth in Mr. Lyttelton's despatch which called for the intervention of Parliament, except, of course, that when a secretary and an adequate secretarial staff were appointed money would have to be found for their salaries, about the granting of which he did not presume Parliament would make any difficulty. He would not dwell upon the points of difference between the way in which the Chairman's despatch formulated the ideas in which they were pretty much all agreed, and the way in which the Committee which he represented formulated them at very much the same time, or in which he would prefer to formulate them if he had a free hand. The despatch of last April was such a very great advance upon anything that had been done officially at any former time, that he thought it would be invidious to make critical remarks upon it in public. He would only state in his own way what the main points of the scheme were. In the first place, there was the Imperial Council or Conference, which in fact would be the existing Colonial Conference, made a business conference, and if necessary, reinforced by representatives of other parts of the Empire. There seemed to be some objection, especially in Canada, to the use of the word Council. That was a matter of the purest detail, for if the colonists preferred to call it an Imperial Conference, that would do just as well as an Imperial Council. The speaker and some of his fellow-workers had thought, at an earlier stage of the proceedings, that a dignified and constitutional way of creating the Imperial Council would be to make it a committee of the Privy Council; but it had been suggested in some influential quarters that people in the Colonies would not like that. That was also a matter of detail, which would be easily settled according to the Conference's desires. The Conference would continue under the proposed plan to be a small and confidential body of between a dozen and twenty members—he hoped not more, because the experience of people who had served on committees was that a committee of more than a dozen was unhandy, and that any large further increase made real confidential and business-like discussion impossible. The secretary of the proposed larger Imperial

Commission would also be the permanent secretary of the Conference—a very important point. The secretary's business would be to keep continuous records of the work of the Conference, and to prepare agenda for its meetings. There would also be attached to the Imperial Conference and its permanent staff what had been called an Imperial Commission. He did not know whether that might ultimately be found the best name for it, but at any rate it would be quite a different body from the Conference itself, although it would conceivably contain some of the same people. It would not be a small confidential advising Council, but rather a large body of persons especially qualified by experience in the various matters to be brought forward. It would be the business of the permanent secretary of the Conference to suggest the right members of that body, and to form it into either standing or temporary committees to examine and report upon particular questions. The Commission would of course be too numerous and too varied to act as a whole; it would be a sort of reserve body which could be called upon in sections as wanted. It was obvious, for example, that the committee to sit and report upon the question of naturalisation in different parts of the Empire would not consist of the persons best qualified to report upon copyright or patent laws or trade marks. There were two observations to be made in connection with the difficulty of getting people from the Colonies to meet in England. One was that, as a matter of fact, there was no time when there were not in England many distinguished servants of the Crown from parts beyond the seas, home on leave or for special business purposes, and also a certain number, although not so many, of distinguished men from the self-governing Colonies. It would be the business of the capable permanent secretary (who would be rather a considerable person, occupying a position quite as good as the permanent under-secretaries of great departments) to look out for these specially qualified persons when they came within reach and to catch them. The work could not be done by the existing departmental officers, because they had a great deal too much of their own business to attend to already, and when the opinion of the experts had been obtained, it might, if necessary, be communicated to the Governments concerned, and it might be found practicable to take some action without waiting for a formal meeting of the Conference. It was by no means obvious that the sections of the Imperial Commission would always have to sit in London; he saw no reason why it might not be convenient to have one special committee, or more, sitting in London, another at Toronto, another at Vancouver, and another at Sydney or Melbourne, according to where the right people were at the time. If the discussion of the business of the Empire could not take place in whatever part of the Empire happened to be most convenient, what was the use of cables? That was one reason why more and better cables were required. It was easy to foresee difficulties. He had had similar experience in connection with University business, and had found that there was a vermin which committed awful ravages in a great many places in public affairs, namely, the red tape worm. If that worm was once admitted to a new department, it would not stop until it had worked its way backwards and forwards through it, and left it in such a mess that it would take a Hercules to cut his way out of it. When the Imperial Commission was started, one or more capable men must be on the spot to take care that no germs of the red-tape worm got in. Having the advantage of starting fresh, it could do so with a minimum of formality, fuss, and written correspondence. A very practical question was, what could the present Government do? The degrees of assent to the proposal of an Imperial Conference were not altogether uniform; some were warmer, some were cooler, and some cautious. The answers from the Cape and Australia were warm, while the answer from Canada was cautious, the French-Canadians being curiously suspicious; but even the French-Canadians, when it was explained to them that the proposal did not touch their autonomy, were perfectly willing to entertain the formation of an intelligence department. He thought Mr. Lyttelton's dispatch was just a little too deferential in that respect, because in his opinion the country was perfectly entitled to say to the Colonies that it could not do its business with existing means, and that it hoped the Colonies would render assistance in the matter, but that it intended to make improved machinery in any case. Having secured the amount of assent which had already been given, he did not see why the Government should not now appoint a Permanent Secretary to the Colonial Conference, without asking for any further consent, and put in train the formation, not only of a secretarial staff, but of an Imperial Commission. They already had the consent of the majority of the self-governing Colonies, and that would very much facilitate the preparation of the business for the next Colonial Conference. One little matter, of some practical significance, was that the official answer from New Zealand had not been received, but there was in this country a High Commissioner for that colony, and he was divulging no secret when he said that Mr. Pember Reeves was not only very willing to forward the scheme, but had been actively engaged in doing so. It would be observed that not a single word had been said in the paper about naval and military affairs. He thought the establishment of an Imperial Conference would ultimately tend to simplify the question of Imperial defence and make it more homogeneous and efficient. There were, however, so many business interests connected with the proposal that it was quite unnecessary to consider naval and military aspects, especially as, to all appearances, there was a good deal less anxiety at the present moment in regard to military dangers to the Empire than there had been at any time within the

last ten years. There was no intention whatever of interfering with the technical functions of the Imperial Defence Committee, which was doing its work extremely well. The proposal made was based on practical, peaceful business organisation, and on that ground alone they were content to let it stand.

Dr. PARKIN thought there could be no doubt that the greatest political problem of the world is whether the British Empire will hold together or go to pieces; and the most probable dissolvant of the Empire is ignorance. No person was fit to govern a great nation unless he knew it intimately; and, in a like manner, unless the people of the Empire knew its different parts, the Empire could never be held together. Starting from that point, the great argument in favour of the scheme they had been considering was that it was probably the most practical expedient within reach to dispel ignorance. In the recent electoral conflict, hundreds of thousands of votes were given by people who did not in the least know what they were voting for; but anyone who, like myself, was familiar with the Colonies knew perfectly well that to make great colonial questions the playthings of English politics would prove fatal, unless there was great intelligence at the back of it. The suggested Conferences would be the means of bringing the wisest and clearest headed men who were ruling the great outer parts of the Empire immediately in contact with the Government in England. Everyone who had watched the Colonial Conferences had seen that the great difficulty was, that when those men met together, the subjects they had to deal with were so vast, and the range of information which each man had at his disposal was so inadequate for dealing with the other countries concerned, that it was almost impossible to make a really business-like and effective Conference do its work well; and there was no possible way in which that could be remedied except by previous preparation. The great intelligence department suggested by Mr. Drage would be able to concentrate the information obtained from the ablest possible men, so that when the Prime Ministers met together there would be placed before them adequate information on which to arrive at a conclusion. The people in the Colonies would also have an opportunity of studying the question, and would know on what grounds the opinions of their representatives were formed, so that there could be no doubt at all of the good and the immense influence which the suggested organisation might have on the affairs of the Empire. But he did not think that would be final, and he was sorry in that connection that Sir Frederick Pollock had thrown cold water on the old idea of National federation. He still held the view that any Commission of the kind proposed would only lead up to a higher organisation; and he did not believe the highest National ideal would be realised until some system had been completed by which the Empire could act effectively and unitedly in time of war, and carefully study all national questions in time of peace. He did not despair of the day when there would be an effective representation of all the different parts of the Empire, which would give the Empire as ready a means of acting as a nation as Germany or the United States possessed. He believed this conld be done without interfering with the autonomy of the separate parts. The whole of the developments of science were bearing in that direction; and if there was a system of cheap National telegraphs all round the world, the Empire would think as one nation. But he was quite prepared to agree with Sir Frederick Pollock that, at the present time, and considering the passing mood of some of the great Colonies, the suggested scheme was probably as far as one could expect to go, and he was prepared to assist it in every possible way, because he thought it was a practical step which would help to disperse the prevalent ignorance on all Imperial questions, and would enable all to work in a logical and concentrated way for the development of the interests of the Empire.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to the author for his interesting paper, which Mr. Drage briefly acknowledged, and the meeting terminated.

THE INDUSTRIAL USES OF ALCOHOL IN GERMANY.

In Germany the great sources of alcohol for industrial and other uses, apart from the small amount that is produced for drinking and medicinal purposes from grapes, cherries, and other fruits, are potatoes, grain, and the molasses, derived as a secondary product, from the manufacture of beet sugar. From the official statistics of the last year's returns, the following figures are derived which show the total production of alcohol from each of the three materials during the year 1904:—Potatoes, 66,000,000 gallons; grain, 15,000,000 gallons; best molasses, 3,000,000 gallons; total, 84,000,000 gallons. Several years ago, when the motor vehicle for military and industrial purposes began to assume a new and extraordinary importance, the German Government became impressed with the necessity of building motors which could be worked with some liquid fuel that could be produced in Germany, in the event that, through the chances of war or other cause, the supply of imported benzine and other petroleum products should be cut off. Alcohol offered the solution of this problem, and all the influence of the Government was exerted to encourage its production, and its more extended use for motor purposes. Prizes were offered for the best alcohol driven vehicles for military and agricultural purposes, and all the great gas-motor builders gave great attention to improving and perfecting engines specially adapted to the use of alcohol as fuel. At this time, according to the United States,

Consul-General at Berlin, a powerful organisation known as the "Centrale für Spiritus-Veruerthung," with central offices at Berlin and branches throughout the Empire, was established, and began a systematic, persistent campaign to encourage and extend the use of alcohol for various industrial purposes, especially heating, cooking, and lighting. Special exhibitions were held from year to year, in which were displayed the whole apparatus and process of alcohol production from potatoes, corn, and molasses, motors of various types and sizes for marine, agricultural, and industrial purposes, and a vast assortment of alcohol stores for heating, cooking, ironing, &c., and lamps and chandeliers in endless variety in which alcohol vapour, burned inside an incandescent mantle, produced a light of high intensity, and cheaper for rural districts of Germany than either electricity or petroleum. The net result of all this systematic effort has been to extend so rapidly the use of alcohol for heating, lighting, and chemical manufacturing purposes, that when the drought of 1904 reduced somewhat seriously the output of potato alcohol, the previous surplus was exhausted, and the price advanced until alcohol became too costly for use as fuel for motors. The consequence of all these conditions has been that while the general use of alcohol for industrial purposes, heating, lighting, and a vast range of chemical and other manufacturing purposes, has steadily increased in Germany, the percentage of the whole product that is used for motor purposes is relatively small, and so far from increasing, is said to be diminishing, though exactly to what extent, it would be difficult to prove. A few Germans, from patriotic motives, use alcohol for driving automobiles, motor boats, and farming machinery. A single store in Berlin, which ordered its equipment of delivery carts four years ago, during the height of the alcohol promotion movement, still consumes annually 18,000 gallons of alcohol for driving them, but mixed, for greater efficiency with about 15 per cent. of benzole. It has been found by elaborate tests, that the economy of alcohol as a fuel for gas motors, is largely increased by its being carburetted through admixture with a certain percentage of benzole, or other product of mineral oil. For a time, it was believed that this admixture of benzole could not be safely carried beyond 20 per cent., but more recent experience has shown that a mixture of equal parts of alcohol and benzole can be used, especially in large motors, with entire safety and economical results. For automobile purposes, the usual proportion is now about 30 per cent. of benzole or gasoline, but at the present cost of alcohol it cannot compete, on the score of economy, with mineral hydro-carbons in a country where they are either produced, or imported free of duty.

There are now in use in Germany rather over 2,000 stationary or portable alcohol engines, exclusive of the spirit motors used in automobiles. They consumed in 1904 about 800,000 gallons of denatured alcohol. Owing to the enormous potato crop of 1901, and the consequent over-production of alcohol, the denatured spirit of the kind used for motors, could be bought in 1903 in any quantity for from 8d. to 9d. per gallon, but this price rose in 1904 to about 1s. 3d. per gallon, at which figure it became more expensive as motor fuel than gasoline. Such is substantially the situation in Germany. The manufacture and industrial uses of alcohol were never so great, so important, or so varied as now. This general increase in the year 1904, compared with the preceding year, was, according to the annual report of the "Centrale für Spiritus Veruerthung," more than 2,900,000 gallons. But notwithstanding the fact that all the leading German manufacturers of gas engines and motor vehicles make alcohol motors that are technically successful, the question of price is the controlling consideration, and of the whole 84,000,000 gallons of spirits produced in 1904, only about 1 per cent. was used for motor purposes.

GERMAN EMIGRATION.

From statistics which have been prepared in Germany showing the emigration from that country in 1904, it would appear that the number of emigrants to trans-oceanic ports during that year was 27,984. Of these, 22,018 sailed from the ports of Bremen and Hamburg, and 26,085 went to the United States. Due in part doubtless, to the fairly satisfactory industrial conditions of Germany during the past decade, there has been a marked falling off of emigration from the German States as compared with former years. Thus in the ten years from 1885 to 1894, the number of emigrants varied from 120,089, the highest number in one year, to 40,964 the lowest, while during the decade ending with 1904, the largest number in any one year was 37,488 (1895), and the smallest number was 22,073 (1901). The emigration for the year 1904 is about the average of the decade. The greatest number of those emigrating in 1904 are reported to have come from the several states and provinces as follows:—Prussia, Bavaria, Saxony, and Würtemberg, these being given in the order of their numerical importance. So far as can be observed in south-west Germany, the emigration results from what may be regarded as ordinary and normal causes, there being no apparent effort on the part of transportation companies and others to stimulate emigration. Doubtless the chief influence is that of Germans in the United States, who, in some cases encourage their friends and relatives to come and join them. The emigration to France along the present French border among families of French descent in the better circles, is referred to, as showing a tendency to decrease, but to still retain considerabie importance. It would be difficult to ascertain the exact proportion of these emigrants who return to Germany to live, but that a considerable number of them do so there can be no doubt.

ARTS AND CRAFTS.

The English Pottery Trade.—So long ago as the last Paris Exhibition it was forcibly brought home to those interested in pottery, its beauty, and its technical perfection, that all over Europe new efforts were being made and untrodden fields of experiment and progress opened out in the pottery world. Not only were the manufacturers of Denmark, Holland, Germany, &c., seeking (and finding) something novel, but even so conservative an institution as Sèvres was deserting the path of her former triumphs in favour of new and untried ways, and seeking novelties of effect by employing methods which were fresh to her. The English pottery shown at Paris was still largely on the old lines, but things had even then begun to move. The "leadless glaze" outcry may have led some of those who are not specially interested in the trade to infer, somewhat too hastily, that English potters were wicked and benighted individuals, determined at all costs to work on old-fashioned and deadly methods, whilst the foreign manufacturers alone were trying to produce their wares under healthy conditions, and seeking both to achieve once more the results reached by ancient and oriental potters and to strike out from the old trade grooves in new and original directions. Nevertheless it may fairly be said that there are few artistic industries in which such important strides have been made of late years in this country as the making, glazing, and decorating of pottery of all kinds. Our makers have certainly proved that they are not fossils—perhaps, would we but believe it, they have proved somewhat more.

Pottery at the Arts and Crafts Exhibition.—From time to time during the last few years there has been an opportunity of noticing at small exhibitions that one or other of the English manufacturers was trying something new; still the present exhibition of the Arts and Crafts Exhibition Society at London has afforded the first chance of seeing side by side the new productions of Messrs. Wedgwood, Doulton, De Morgan, Sir Edmund Elton, the Pilkington Tile and Pottery Company, and Mr. Howson Taylor, and so made it possible to judge from a fairly representative collection of examples by various makers, what has been done and is being done in the English pottery trade. Messrs. Doulton are getting some fine new effects of colour in what they call "salt-glazed stoneware." The glaze is so glossy, that without reading the description, we should naturally and unhesitatingly have called it lead glaze. Messrs. Wedgwood have, together with Mr. A. H. Powell, been making some experiments. While adhering in the main to their old shapes, they have put them to new uses and decorated them with simple under-glaze patterns in a manner which we do not naturally associate with this firm. Sir Edmund Elton, while working in the main in his old direction, has applied gold leaf to his pottery (under the glaze) which has divided in the lines of the crackle, and has in this way produced quite a new effect. But it is to the two younger makers who have naturally done most in the way of new departures in glazes and methods of work generally. Mr. Howson Taylor, who showed a few pots at the ast Arts and Crafts Exhibition, and who has since then exhibited at the Home Arts, and whose Ruskin ware is now pretty generally known, puts before us a case full of interesting experiments and achievements in which he shows, amongst other things, some remarkable *sang-de-boeuf* and *flambé* pieces of various kinds as well as some strange and rather "flukey" looking bits of colour and some most unusual, though apparently rather accidental crackled and ruckled effects. The Pilkington Tile and Pottery Company have carried further their Lancastrian ware on its original lines, developing particularly the matt fruit skin and the opalescent glazes, and have also produced for the first time lustre ware. Of course, as we all know, Mr. De Morgan has for years been making lustre in England. He has shown less of his work in recent years, and is only represented here by one vase, but he was never trying for precisely the same qualities as Mr. Burton is aiming at, and this new ware, though recalling more vividly than any other modern lustre, the work of the old Persian and Hispano-Moresque potters, is quite unlike anything that has been done in recent years either in England or on the continent. Really no one who carefully examines these various developments can turn away from them with the feeling that English pottery manufacture is in a state of stagnation. Much as we admire in this country the products of Golf San Guan, Pecs (Hungary), Rostrand, and Copenhagen, and other Continental potteries of European reputation, it must be admitted that in England also we are doing at least our share in the field of pottery design and manufacture.

Glass.—The chemical likeness between glazed earthenware or porcelain and glass is so pronounced that the one branch of manufacture seems to lead naturally to the other; and in this industry, too, examples of the newest departures are to be found at the Arts and Crafts Exhibition, which welcomes within its walls the wares of manufacturers who at other times and under other circumstances might have shown their things at separate exhibitions, or not have exhibited them at all. Mr. George Walton's work, though unlike what has been done in England of late, and, therefore, in this respect a new departure, is rather a return to Venetian and Bohemian types, or a revival of the old ideals than a technical advance. The same may be said of Messrs. Powell's shallow cutting on small dish-like bowls, which recalls the beautiful little Roman bowl at Linz, though in the modern examples, of course, the delicate tinting of the glass is deliberate and not the result of age or impurity. Still, we have been accustomed to look upon artistic cut glass as a thing of the

past. This is, it is true, "cut glass," but it is quite unlike the type of work usually designated by the term, being simply the slight cutting away of the material to form a pattern, and not the substitution of a facetted for a plain surface. This kind of work has disappeared for so long that we had almost forgotten its existence; we see here that it is well worth reviving and developing. Though some glass-makers have of recent years produced quantities of brilliant prismatic coloured vases, the latest developments seem to be rather in the direction of pale and delicate colours, though Messrs. Powell show a couple of vases in deep rich deep tones of colour which suggest at first sight pottery glazes. A new effect is produced, too, by means of platinum foil embedded in the glass. This method is, of course, old enough in the case of gold foil, but the effect of its application to platinum is not only novel but quite charming, and promises well for the future. In more delicate vein we have glass of a pure golden tint coloured with oxide of selenium, and white and pale coloured rose bowls, round which are twisted threads of glass varying in tone from blue to amethyst.

CORRESPONDENCE.

"CASH ON DELIVERY" AND SMALL SHOP-KEEPERS.

I have just noticed Miss Webster's remarks concerning my note on the "cash on delivery" system, and perhaps you will allow me few lines to reply. In any house in which disorder is not the rule, servants are instructed not to pay for any message or parcel unless warned beforehand that it is expected (which is always the case with the "cash on delivery" system). The rule could just as well hold good in an hotel, where it is a simple matter to give the porter every morning a card mentioning from what quarter a parcel is expected. I am afraid that where servants and hotel porters have as free a hand as Miss Webster seems to give them, "fraud and annoyance" have fair play in many other ways than by the "cash on delivery" system, and the loss of money caused by the latter is but a small item by the side of the daily waste that lack of system in managing one's servants is certain to cause.

M. E. J. Gheury.

The Woolwich Polytechnic, Woolwich.
March 2nd, 1906.

LONDON TRAFFIC.

I have read with much interest the report of Captain Swinton's recent paper on London traffic at the Society of Arts.

There is, however, one improvement in connection with Kingsway, of which I see no suggestion made, which I should like to mention.

A large amount of heavy traffic of all sorts moving from north to south leaves King's-cross (Midland and Great Northern Railways). To a great extent this at present passes down Gray's-inn-road, congesting at its southern end with the terminus of the trams and the traffic moving west from the City along Holborn. A large part of both of these, I take it, then make for Kingsway, so that the part of Holborn and New Oxford-street, between Staple-inn, Chancery-lane, and Kingsway shows a congested mass of slowly moving traffic.

At a short distance north and south of this district are two broad roads scarcely used for traffic at all being practically blind. I refer to Bedford-row and Lincoln's-inn-fields (east side).

If these two streets could be connected by a broad or double tunnel with an easy slope the aforementioned congestion would be to a great extent alleviated.

The traffic moving into Bedford-row, after a short move through Theobald's-road, would pass through the tunnel under High Holborn, into Lincoln's-inn-square, round either side of the fields, and into Kingsway by a road now being made at the south-west angle of the square, out of what I believe has hitherto been known as Bear-yard.

This should not prove a very expensive improvement, even if it became necessary to buy up the buildings on one side of Hand-court on the north and Great Turnstile on the south.

Hylton B. Dale.

60, Onslow-gardens, S.W.
5th March, 1906.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

March 21.—"Motor Boats." By Bernard B. Redwood, B.A. Sir John I. Thornycroft, LL.D., F.R.S., will preside.

March 28.—"Coal Conservation, Power Transmission and Smoke Prevention." By Arthur J. Martin, M.Inst.C.E.

April 4—"Ramie and its Possibilities." By Mrs. Ernest Hart. Illustrated by Samples manufactured by A. M. Hart, Ltd.

April 25.—"The Production and Collection of the Picture Postcard." By Frederic T. Corkett.

May 2.—"Submarine Signalling." By J. B. Millet.

May 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By Professor Thomas Oliver, M.D., LL.D.

May 16.—"Watermarking in Hand and Machine Papermaking." By Clayton Beadle.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

April 26.—Colonel Sir Arthur Henry McMahon, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

May 24.—Major Percy Molesworth Sykes, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

May 1.—"Social Conditions in Australia." By the Hon. J. G. Jenkins, Agent-General for South Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock:—

March 20.—"English Royal Heraldry." By Cyril Davenport, F.S.A. William A. Lindsay, K.C., Windsor Herald, will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

Prof. Vivian B. Lewes, "Fire: Fire Risks and Fire Extinction." Four Lectures.

Lecture II.—March 19—Fire Risks—Matches—Defective Flues and over-heated Stoves—Action of Heat on Wood—Pyrophoric Carbon—Lighting Dangers—Candles, Oil Lamps, Gas, and Electricity.

Lecture III.—March 26.—Storage Dangers—Spontaneous Ignition of Material in Bulk—Lampblack—Charcoal—Coal—Fibre—Greasy Waste and Rags—Vapours—Dust and Dust Explosions—Nitro Compounds—Collodion Goods.

Lecture IV.—April 2.—Fire Prevention—The Fallacies Existing as to Fireproof Material—Stone and Iron *versus* Wood—Heat Conductivity—Fireproofing Wood and Textile Fabrics—Fire Extinction—Sprinklers—Chemical Fire Extincteurs—Alarms.

Alfred Maskell, "Ivory." Three Lectures.
April 23, 30, May 7.

George W. Eve, "Heraldry in Relation to the Applied Arts." Three Lectures.
May 14, 21, 28.

MEETINGS FOR THE ENSUING WEEK.

Monday, March 19...SOCIETY OF A John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Vivian B. Lewes, "Fire, Fire Risks, and Fire Extinction." (Lecture II.)

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Professor J. W. Gregory, "The Economic Geography of Australia."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Sidney Perks, "Flats."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Miss Eleanor Hull, "The Early Celtic Church of Britain and Ireland."

Tuesday, March 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Cyril Davenport, "English Royal Heraldry."

Royal Institution, Albemarle-street, W., 5 p.m. (Tyndall Lecture.) Dr. J. E. Marr, "The Influence of Geology on Scenery." (Lecture I.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. H. Shelford Bidwell, "The Outer Barrier, Hodbarrow Iron Mines, Millom, Cumberland."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m.. Prof. C. S. Loch, "Statistics of Population and Pauperism in England and Wales, 1861-1901."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Rev. Prof. G. Henslow, "Parasites and Saprophytes among Flowering Plants."

Wednesday, March 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Bernard B. Redwood, "Motor Boats."

Meteorological, 70, Victoria-street, S.W., 7½ p.m. Dr. H. R. Mill, "South Africa as seen by a Meteorologist."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. C. F. Rousselet, "A Contribution to our Knowledge of Rotifera of South Africa." 2. Mr. E. M. Nelson, "The Resolving Limits for the Telescope and the Microscope."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Thursday, March 22....Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.

Royal Institution, Albermarle-street, W., 5 p.m. Prof. B. Hopkinson, "Internal Combustion Engines." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 4 p.m. 1. Mr. C. P. Parks, "Electrical Equipment of the Aberdare Collieries of Powell Duffryn Company." 2. Mr. W. C. Mountain, "Electric Winding considered Practically and Commercially."

Friday, March 23...Royal Institution, Albemarle-street, W., 9 a.m. The Earl Roberts, "Imperial Defence."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) F. K. Stevens, "Waves."

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Mr. A. W. Soames, "The London Clubhouse of last Century."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W.

Saturday, March 24...Royal Institution, Albermarle-street, W., 3 p.m. Prof. J. J. Thomson, "The Corpuscular Theory of Matter." (Lecture IV.)

Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, MARCH 23, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 26, 8 p.m. (Cantor Lecture.) PROFESSOR VIVIAN B. LEWES, "Fire, Fire Risks, and Fire Extinction." (Lecture III.)

WEDNESDAY, MARCH 28, 8 p.m. (Ordinary Meeting.) ARTHUR J. MARTIN, M.Inst.C.E., "Coal Conservation, Power Transmission, and Smoke Prevention."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 19th inst., PROF. VIVIAN B. LEWES, delivered the second lecture of his course on "Fire, Fire Risks, and Fire Extinction."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday, March 20; WILLIAM A. LINDSAY, K.C., Windsor Herald, in the chair. The paper read was "English Royal Heraldry," by CYRIL DAVENPORT, F.S.A.

The paper and report of the discussion will be published in a future number of the *Journal.*

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, March 6; THE RIGHT HON. LORD STRATHCONA, G.C.M.G., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said no one could be better fitted than Sir Nevile Lubbock to read a paper on the West Indies, for which he had done so much, and with which he had been connected commercially for so many years. It was to Sir Nevile that the West Indies owed the central system, by which it was possible to cultivate sugar there at a profit instead of, as formerly, at a loss. He also introduced cane farming into Trinidad, and that had become a large industry.

The paper read was—

IMPERIAL QUESTIONS IN THE WEST INDIES.

By SIR NEVILE LUBBOCK, K.C.M.G.

Any one looking at the West Indies on a map of the Western Hemisphere sees a number of small islands situated apparently close to one another. That all these small islands should be federated under one Governor would appear only natural and reasonable, whilst the fact that most of them have their own separate and independent Government, with a separate Governor, seems to be foolish and unnatural. But if we examine the facts in regard to these colonies more closely, we shall find that the existing conditions of their government are not so unreasonable as a casual glance at a small map would lead one to suppose. In the first place, the islands, although small compared with European countries, are not so small as they appear in a map of the world, and their distances from one another are considerable.

Commencing with Jamaica in the north, the largest of the West Indian Islands, we find that it is approximately 144 miles in length by about 50 miles in breadth, with a population of about 785,000 souls. About 1,000 miles due east of Jamaica we have St. Kitts, with an area of 60 square miles and a population, including Nevis and Anguilla, of about 43,000, and passing southwards, Antigua, with an area of about 108 square miles and a population of 34,000; Dominica, with 291 square miles and a population of 29,000; St. Lucia, with 233 square miles and population of 51,000; Barbados, 166 square miles and a dense population of nearly 200,000; St. Vincent, 132 square miles, population 48,000; Grenada, 133 square miles, population 66,000; Trinidad, 1,750 square miles and population of about 280,000; Tobago, 114 square miles and population of 19,000. But there is another colony which is generally associated with the West Indies, that is to say, British Guiana, on the main coast of South America, situated 120 miles south-east of Trinidad from point to point, or about 365 miles from Port of Spain, the capital of Trinidad, with an area of 100,000 square miles and a population of about 300,000, of whom some 10,000 are aboriginal Indians.

Let us now consider the distances between these colonies. Starting this time from British Guiana and working north, we have, as we just said, from British Guiana to Trinidad 365 miles from port to port; Trinidad to Grenada 94 miles; from Grenada to St. Lucia 160 miles; from St. Lucia to Dominica 94 miles; from Dominica to Antigua 145 miles; from Antigua to St. Kitts 60 miles; whilst from Jamaica to Barbados the distance is 1,042 miles; and from Barbados to Trinidad 210 miles.

When we consider the importance of some of these colonies, such as Jamaica, Barbados, Trinidad, and British Guiana, together with the distances which separate them, it seems evident that one Government, *i.e.*, one Governor and one Legislature for all of them, is practically out of the question. It is clear that a legislative body sitting in Jamaica could never satisfy the people of Barbados, Trinidad, or British Guiana, or *vice versa*, and for this reason, amongst others, that the right class of people for legislative purposes from Trinidad, British Guiana, and Barbados would not be induced to spend a large amount of their time yearly in Jamaica; they could not afford to. It must always be remembered that in the West Indies there does not exist a large leisured class such as we have in this country. The best men in all these colonies are just the men who have most to do and are most tied to the colonies in which they live; then they are to a large extent forced to come to Europe every five years or so, and this practically absorbs such time as they are able to spare away from the colony to which they belong.

But, it may be asked, would it not be possible to have one Governor-General for the whole of the West Indian colonies, leaving the local Legislatures as they now exist? There certainly would seem to be no difficulty; but it would cost money. Such a Governor-General, to be of real use, would require to be a man of importance in this country, a man whose opinion would carry weight in the House of Commons; and it is obvious that such a position must carry a high salary, and there would require to be provided suitable accommodation, staff, &c. It seems likely that the cost first and last would be not less than £10,000 to £12,000 per annum, and it may be asked what would be gained. An efficient Colonial Secretary ought to be able to do as much for the colonies as such a Governor-General. Nor would the appointment of a Governor-General do away with the necessity of having as many, or almost as many Governors as there now are. It is true that they would probably be called Lieutenant-Governors, but they would be essentially the same class of men as the existing Governors, and would involve approximately the same expenditure.

Although, however, a federation of all the West Indian colonies appears to offer great, if not insuperable, difficulties, at any rate for the present, it does not follow that nothing can be done. In fact, some steps have already been taken towards unification. Antigua, St. Kitts and Nevis are already embraced under one Government with one Governor. Tobago and Trinidad are under one Government. It has recently been proposed, I understand, by the Colonial Office that Grenada and St. Vincent should be combined into one Government with one legislative body. It seems doubtful if this would be a satisfactory arrangement; although already Grenada, St. Vincent and St. Lucia are under one Governor, each has its own legislative body. It seems, therefore, that the idea of federation has not been lost sight of, and that events are moving in that direction as fast as circumstances permit. I can conceive that something might be done towards this end by the gradual assimilation of the laws of the different

colonies, and by the assembling from time to time of delegates from all the colonies to confer together upon subjects of general interest, such, for instance, as postal or telegraphic services, quarantine regulations, exhibitions, and possibly in time to come, tariffs. Already the annual meetings to consider agricultural and industrial questions, which have been inaugurated by Sir Daniel Morris, the Imperial Commissioner of Agriculture for the West Indies, do much good, even apart from the useful information they disseminate, in bringing together leading men from the different colonies. In one respect all will be agreed, viz., that however much federation may be a desirable aim, it is a process which must not be hurried, and still less rushed. Any attempt to do so would do far more harm to the cause than good. We of course cannot see the future, but things which do not appear possible to-day may, in the course of years, assume quite a different complexion.

It is no use trying to go against nature, and there can be no doubt that, in the case of the West Indies, nature has placed great difficulties in the way of their consolidation under one government or one legislative body. I have used the word "federation," although strictly speaking it does not properly apply to the fusing together of colonies, but it is a convenient word and is generally understood in the sense in which I have used it.

In an article in "The Journal of the Society of Comparative Legislation," of August, 1900, on "The West Indies and Confederation," written by my old friend, Mr. Wallwyn P. B. Shepheard, he very pithily sums up the matter thus:—

"The conclusion seems to be that the policy of so-called 'confederation' has evolved complication rather than simplification in the Government and Legislatures of the West Indian communities. . . . The real bond of union is the Crown. The desire for union seems satisfied by the common allegiance, but for unity into one colony, province or dominion, no desire is apparent, nor would it be easy to give effect to such a desire were it to arise. . . The islands are separated by miles of sea, and to a closer and more territorial political union it may be said *opposuit natura*."

Another Imperial question has been discussed during the last few months, viz., what has been called confederation with Canada. It appears that at a meeting of the Maritime Board of Trade at Halifax (Nova Scotia) held on August 20th last, a resolution was unanimously passed to memorialise the Dominion Government to take steps to secure the federation of the West India islands with Canada, and the delegates at the meeting made strong speeches in support of such a scheme, arguing that it was for the best mutual interest of Canada and the West Indies that such a union should be effected. Some speakers stated that the feeling in the West Indies was favourable to such a proposal. We must bear in mind that the Maritime Board of Trade is an important body, representing the Boards of Trade of the three maritime provinces of Nova Scotia, New Brunswick, and Prince Edward Island. It is evident, one would think, that a resolution of such a far-reaching character would hardly have been passed by an important representative body without mature consideration and some very definite idea of what is meant by it, and yet directly one attempts to discuss the idea one is immediately pulled up by the difficulty of realising what is really meant. Is the idea that the West Indian colonies should become a province of Canada, or that each West Indian colony should become a separate Canadian province? We have already seen the great natural difficulties in the way of a federation or unification of our West Indian colonies, and, of course, exactly the same difficulties would exist in regard to their unification in such a way as to enable them to become a province of Canada. Then, I can hardly imagine that it could be seriously proposed to admit each separate colony as a province of Canada, and we may perhaps postpone the serious consideration of such a proposition until there is some evidence that it would be welcomed in Canada.

It has been suggested that the meaning of the resolution is that Canada should be substituted for the Colonial Office in its relation with the West Indies. Now, whilst I am afraid that I cannot go so far as to say that the relationship between the West Indies and the Colonial Office has at all times been entirely ideal, still, if Canada is to step into their shoes, one would like to have some evidence that the change is likely to be an advantageous one for the West Indies. It is difficult at present to see where the advantage would come in. It is true that the Canadian Parliament recently showed their good will to the West Indies by giving West Indian sugar favoured treatment in regard to its admission into Canada, and no doubt the reduction of $33\frac{1}{3}$ per cent. on the duty upon West Indian sugar was intended to benefit the West Indies.

As a matter of fact, however, it has only done so to a very moderate extent, the bulk of the apparent advantage having been intercepted by the Canadian sugar refiners.

It seems probable that the idea of commercial reciprocity between Canada and the West Indies has led, possibly without due reflection, to the suggestion of federation. This question of commercial reciprocity is not a new one, and has been frequently considered in the West Indies, and is no doubt much favoured in Canada. Hitherto there have been difficulties of a serious character, but they are difficulties which are becoming much mitigated, and in time, possibly a short time, may disappear altogether. It may be useful to point out some of these difficulties.

In the first place, we must always remember that one of the nearest neighbours to the West Indies is the United States, with a population of 75,000,000 against a population of some 5,000,000 in Canada. Moreover, for many years past they have been the best customer the West Indies have had, although there seem to be good reasons for believing that they will not be as good customers in the future as they have been in the past. With the heavy protection the United States gives to her own beet sugar production, to the cane sugar production of Louisiana, Hawaii, and Puerto Rico, and the privileged treatment of Cuba and Manila sugar, it seems obvious that the demand for British West Indian sugar may, before many years are passed, cease altogether. How many years may elapse before this takes place no one can say. On the one hand, we have a steadily increasing production in Cuba, Puerto Rico, and Louisiana, and in home-grown beet, and now likely also to take place in the Philippines; on the other hand, there is a rapidly increasing consumption in the United States. Then, again, as regards fruit, the protection to home-grown oranges has shut out British West Indian oranges, and it is quite possible and not improbable that the same policy may be applied to bananas, and might have the same effect upon British West Indian bananas. With cocoa, however, the case is different; this is largely exported from the British West Indies to the United States, and unless they should start a production of their own, this market is likely to continue to be a large one for British West Indian cocoa. A consideration of these facts leads me to the conclusion that the time has not yet arrived when the West Indies can afford to dispense with so good a customer.

Now let us see how it is with Canada. We have already seen that she gives British Colonial sugar a preference, and the result of this has been that her imports of West Indian sugars are increasing; and in view of the fact that the Canadian consumption is rapidly increasing, there seems every likelihood that before many years she may be able to take the whole of the West Indian production of sugar, in which case her preferential treatment of British Colonial sugar would undoubtedly be of considerable advantage to the West Indies.

It would seem, therefore, that whilst the United States market is a shrinking one for West Indian products, the Canadian market, on the contrary, is an expanding one, and these circumstances seem to indicate that the day is not far distant when some mutually satisfactory commercial arrangement will be possible between Canada and the West Indies.

So far we have considered the advantages to the West Indies, and it is necessary to examine the question from the Canadian side. Amongst the chief articles of import into the West Indies we find lumber, salt fish, and flour, and these mainly come from the United States, but could equally well come from Canada, and a very small differential duty would probably be sufficient to give Canada the whole of this trade. No doubt the advantage of such preferential trade is the prevailing factor which makes Canada desirous of a closer commercial connection with our West Indian colonies. There can be no doubt that both on the part of Canada and on that of the West Indies, there exists the best of good will, and there seems to be nothing to prevent a mutually advantageous arrangement being come to between them when once the time is ripe. It is understood that invitations have been addressed by Canada to the West Indian colonies to send representatives to Canada to discuss this question, and it may possibly be that events have already sufficiently modified the circumstances as to warrant some attempt being made to bring about those closer ties which all well-wishers of the Empire would gladly welcome.

There is one other matter I wish to allude to, namely, the standing grievance of the West Indies in the preferential treatment given to the distilling interest of this country as against the West Indian rum producers, in the form of the surtax on spirits imported into this country, over and above the normal spirit duty. This surtax, which amounts to 4d. in the case of rum and 5d. on spirit for methylation, is

supposed to be a set off against the loss to the home distillers owing to the nature of the regulations in connection with distilling in force for the purpose of collecting the revenue. The argument under which the distillers lay claim to this preference is that colonial distillers are not subject to the disabilities resulting from the operation of Government control to the extent that they are, and that the amount of the surtax is if anything inadequate to meet the loss. If the colonial regulations are not so stringent as the home, they are considered by those responsible for them, and have been approved by the Home Government as being sufficient to protect the revenue, and it is in the power of the respective Governments to make them as strict as they require. It is hardly necessary, however, to go into this portion of the question, as there is every reason for believing that the facts of the case do not bear out the claim of the home distillers, and that the major part of the items of loss for which they are given compensation in this form do not exist. Certainly when it is remembered that a portion of the amount is claimed as rebate for a duty on grain which has been abolished for years, and another and the larger for the loss of duty paid spirit which has never paid duty, sufficient grounds exist for an impartial inquiry being made into the matter. Hitherto all representations have been shelved or inquired into in an *ex parte* manner. As I have already stated, the amount making up the surtax is composed of specific items, and it is due to the colonial distiller to give him every opportunity to make his case good. In 1902 Mr. Steele, C.B., was commissioned by the Treasury to enquire into the West Indian and British Guiana regulations, and to report to the Treasury on the bearing on the distiller, but no opportunity has been given to the colonial distiller, nor has his claim been recognised to have his allegations inquired into or proof given him of the justice of the home distillers' position.

In conclusion, it is gratifying to feel that the great bar to the prosperity of the West Indies, that is to say, the sugar bounties on the Continent, have now ceased, and I have no doubt if this state of things continues that the future history of the West Indies will be of a more satisfactory character than that of the past. We cannot reasonably expect that any prosperity which may be in store for them should be of rapid growth; it is bound to take time. It must be remembered that the removal of the sugar bounties has not given them any artificial advantage whatever in their competition; it has merely removed what was an artificial disadvantage to them and others. They are still, and will continue to be, exposed to the severest competition, a competition which is aggravated by the fact that the United States, the largest sugar-consuming country in the world, continues to give very considerable artificial advantages to its own producers, including those of Puerto Rico and Hawaii, and also favoured treatment to those of Cuba and Manila. It may be reasonably expected, however, in view of the plucky manner in which they have fought a one-sided battle for the last thirty years, that the West Indies will give a satisfactory account of themselves in the future, and continue to be a creditable portion of that British Empire of which they are some of its earliest colonial possessions.

DISCUSSION.

The CHAIRMAN said he felt sure that all present had listened with the greatest interest to a well-conceived and admirably-condensed paper. He had been pleased to hear Sir Nevile Lubbock's references to the relations between the West Indies and Canada. As the author had said it was often wisdom to "make haste slowly;" if they ran into confederation or federation prematurely they might find afterwards that there were many things to be considered that ought to have been taken into account beforehand. But much had been done during the last four or five years which was of advantage to both peoples. As had been said, Canada already took at least two-thirds of the whole of the sugar produced by the West Indies. It was mentioned that that was taken by 5,000,000 people. The population of Canada four or five years ago was a little over 5,000,000, but to-day it considerably exceeded 6,000,000, and it was being increased by immigration alone at the rate of 150,000 yearly, of whom 30,000 or 40,000 came from the United States. The latter were as well adapted as those from the mother country to make the best class of settlers and farmers, and they would be every whit as loyal and as devoted to Great Britain and the Empire as were the members of the audience. When Canada gave preference to the mother country and some of the colonies, Germany at once cut the Dominion off from participation in the "Favoured Nation" clause and imposed higher duties against her. Canada rightly considered that she had perfect liberty to give the mother country and the colonies any advantage she deemed proper, irrespective of what might be thought by foreign countries. Germany's action was met by Canada putting on a surtax against that country. At the same time, Canada granted a rebate to the West Indies. Formerly Ger-

many sent to Canada sugar to the value of nearly 3,000,000 dollars; at present, the value of such exports from Germany to the Dominion was only 200,000 or 300,000 dollars. The remainder, amounting in value to some 2,700,000 dollars, was now received from the West Indies instead of from Germany. That he regarded as a very good beginning, and all would be glad to see an advance in the same direction, even though it be slow. In less than ten years there would probably be from eight to ten million people in Canada, and then they would be able to take the whole of the produce of the West Indies. The author had referred to a statement made as to the properties of flour from Canada being such that it did not keep well. He (Lord Strathcona) had had practical experience in that connection. He was for many years connected with the old Hudson's Bay Company, which received the greater portion of its flour from Canada. Some also came from England and some from the United States. He could say, from his own knowledge, that the wheat from Canada was quite equal in keeping quality to that from any other country. In fact, he knew Canadian flour to keep in good condition for two years. There was another point that was sometimes not sufficiently taken into consideration, namely, the fact that winter wheat was now grown in North-West Canada. Formerly it was all spring wheat; there was no attempt to grow wheat by putting it down in the autumn. But it had been found that they could grow with equal advantage "fall" wheat in Western Canada. That was looked upon as special "keeping" wheat. Canada would be very glad to get into still closer relations with the West Indies, those very beautiful islands of which all had heard from their infancy. He could go back more than 70 years in recollection of the delicious things that came from the West Indies. But at that time those islands were very prosperous indeed, and it was a question with the young man of England—and of Scotland too—whether he should go to the East Indies or to the West Indies. Going to one or the other meant, unless it were their own fault, that they would prosper. He hoped that that prosperity might return, and that it would he had no cause to doubt.

Sir David M. Barbour, K.C.S.I., K.C.M.G., said that Sir Nevile Lubbock's experience and knowledge of the West Indies were so much greater than his own, that it would be little less than presumption on his (the speaker's) part to attempt to criticise the paper at any length. He was not, however, entirely ignorant of the West Indies; he had been a member of the Royal Commission which inquired into the condition of the sugar-growing colonies of the West Indies some years ago, of which Commission the late Sir Henry Norman was Chairman, and of which Sir Edward Grey, the present Foreign Secretary, was a member. He (Sir David) afterwards visited Jamaica to inquire on behalf of the Colonial Office into the financial difficulties into which that colony had fallen. One of the questions which came before the Royal Commission was that of the federation of the West Indies. It was said by some that all those islands could, with advantage, be placed under one Governor, or one Governor-General. In that matter he agreed with Sir Nevile Lubbock. He could not see how it was possible, with advantage, to confederate the West Indies and place them under one Governor. Such a Governor would have to be under the Colonial Office; matters would be referred from the small islands to the Governor-General, but he would not have the final voice; the question would have to be submitted to the Colonial Office, just as was now the case in Indian affairs, the final voice in the case of India being that of the Secretary of State for India. He did not see how the Governor-General could be given a satisfactory Council, either legislative or executive. It would not be possible to get the best men to go for four, five, or six months from their own island, to an island 600 or 800 miles off. There was no class in the West Indies which could undertake that duty. With regard to the proposal to place the islands of the West Indies under Canada, he agreed with Sir Nevile Lubbock that there would be great difficulties in devising a satisfactory arrangement, and he did not think it was possible. But, of course, Canada and the islands of the West Indies might find it to their advantage, or think it was to their advantage, to enter into certain trade relations, giving preferential or reciprocal advantages to each other. Without pronouncing any opinion as to whether that was a wise policy, he thought that if Canada and the West Indian Islands wished to follow that policy, no one should raise objections. He quite recognised that the position of the West Indies in reference to the United States was a peculiar one. The United States would naturally be the chief customer of the West Indies, but there were liable to be numerous tariff changes in that country which might seriously affect the industries of the islands. On this account there seemed to be a stronger justification than would otherwise be the case for their entering into special relations with Canada. He desired to speak on only one further matter, namely, the surtax of 4d. per gallon on rum. The Royal Commission, of which he was a member, recommended that that surtax should disappear, and he recollected quite well that the then Chancellor of the Exchequer was very indignant about the matter. A deputation from the distillers of this country waited on the Chancellor, and he conveyed to them his astonishment that the Commission should have made such a monstrous proposal. Yet, notwithstanding the high authority which necessarily attached to the opinion of the Chancellor of the Exchequer of this country in all fiscal questions, he (Sir David) adhered to his original opinion, namely, that the surtax was unsound from a theoretical point of view. But when he went to Jamaica afterwards and that question was raised before him again, he had to point out that in Jamaica they put an extra tax on British whisky,

as compared with Jamaica rum, to the extent of some 6s. or 8s. a gallon. He said to the people of Jamaica that before they asked the Chancellor of the Exchequer to remove that mote of 4d. a gallon from his eye, they had better withdraw the beam of 8s. a gallon from their own.

Mr. WALLWYN SHEPHEARD said it must be a satisfaction to all those interested in the West Indies to gather from so eminent and up-to-date authority on those Colonies, as was Sir Nevile Lubbock, in his exhaustive review of their present position, that not one of the questions he had dealt with could be regarded as a burning question. The really burning question had now been terminated in the abolition of the foreign sugar bounties, which threatened at one time to disrupt the whole of the West Indies. Many years ago that question was debated in this hall. The policy of enforcing free trade by positive action then advocated had succeeded after some thirty years' agitation. The Sugar Convention was the outcome. It was not the Convention itself which abolished bounties; international Europe had already determined that they must cease, and the Convention did no more than fix the date. Already the cane-sugar industries were reviving and holding their own against beet sugar. He was not a sugar expert, but what satisfied him as to the natural superiority of cane sugar over beet sugar was the fact that the sugar in the cane was produced above ground, whilst the sugar in the beet was elaborated below the ground. Sir Nevile Lubbock had spoken on the subject of confederation, and had been good enough to quote with approval from an article he (the speaker) had written six years ago. He still adhered to the views on confederation then expressed. He thought the distinction between colonies acquired by settlement and those by conquest in respect of their laws and constitution should not be lost sight of. When Englishmen sailed away in Elizabethan days to discover lands unoccupied by Christian prince or people, they took with them charters of the Crown, under which the early settlements were made, and these were based on the rights and liberties enjoyed by Englishmen at home. These charters were, no doubt, drawn up by the lawyers of those days in Lincoln's Inn and the Temple, and contained all legislative and executive powers suitable for a colony, reserving only in express terms the primary allegiance and sovereignty in respect of the acquired possessions; "Salvâ semper fide et ligeantiâ, ac dominio directo, nobis, heredibus, et successoribus nostris debitis." In his (the speaker's) view this primary allegiance was the true bond of the Empire, and as such it had ever tended to secure the state or condition of peace, and this at the present time, and had for many years past, prevailed in the West Indies.

The Hon. Sir HORACE TOZER, K.C.M.G. (Agent-General for Queensland), said the continuous work of Sir Nevile Lubbock in getting the sugar bounties abolished was of great value to that portion of Australia which he (the speaker) represented. He looked upon the West Indies not only for what they were at present, but as a colony that was going to be a much more important producing part of the British possessions than was the case at present. As soon as the Panama Canal should be opened, the West Indies would assume a different relationship with the Empire. He foresaw great possibilities resulting from intercourse with the Islands on the part of Australia; at present the Panama Isthmus shut out direct sea communication with the West Indies from Australia and New Zealand. He would carry the observations which had been made about Canada a step further. He liked to hear of all portions of the British Empire working together and making the best use of the family connection. He did not think the last observation of Sir David Barbour concerning the surtax concluded the whole matter. From the point of view of the Australian, and of one who produced sugar and other commodities, he would say the matter must not be looked at altogether from the point of view of the motherland. The view he wished to impress was, that in a young country much had to be done which people in England did not understand. It had got to produce a revenue, and in trying to do so it had to do very much what a child did for its parent, namely, do the best it could; and if the colony, in its own interest, had, by way of revenue, to put a tax upon things which came from this country, it was not put on in the way of protection or restriction. The West Indies seemed to establish, and Australia supported them in that, that the claim for a surtax upon rum should be abolished. He had been intensely interested in the historical description of the West Indies, much of which was new to him, but he was more interested in the fact that at the present moment there seemed a likelihood that they would be much more important in the future. Nobody should lose sight of their value to the Empire.

The CHAIRMAN said his one remaining duty, and a very pleasant one, was to ask the audience to permit him to join with them in a most cordial vote or thanks to Sir Nevile Lubbock, which he was sure all were most desirous of according to him.

The resolution of thanks was carried unanimously.

Sir NEVILE LUBBOCK expressed his high appreciation of the manner in which his paper had been received, and he desired to specially thank Lord Strathcona personally for the important remarks he had made, and also Sir Horace Tozer. He agreed with Sir Horace that when the Panama Canal should be opened it would completely change the aspect of commercial facilities in the West Indies. He feared, however, it would yet be some years before that was accomplished. He had been gratified to hear Sir David Barbour's agreement with what he (Sir Nevile) said about confederation, and he believed

the same gentleman found himself in practical agreement with what the paper said about the commercial relations of the West Indies with Canada. In reference to Sir David's remark about the whisky tax in Jamaica, he thought Sir Horace Tozer had practically answered that. No doubt in some of the old and new colonies it was often difficult to know how best to raise revenue. He presumed Sir David Barbour would not have objected to the high tax on whisky if there had been an equivalent Excise duty on rum. But he thought Sir Horace Tozer would agree that an Excise duty in the Colonies was one which was difficult to collect; in Jamaica, for instance, there were large tracts of country and uninhabited mountainous regions. The amount of whisky going from this country to Jamaica was a mere bagatelle; it was not of any great importance.

Sir FREDERICK YOUNG, K.C.M.G., said he had been particularly struck with the remark made by the Chairman respecting Canadian flour. Coming from so high an authority it had impressed him very much indeed in contrast to the statement quoted by Sir Nevile Lubbock comparing the keeping qualities of Canadian and United States flour.

SIXTEENTH ORDINARY MEETING.

Wednesday, March 21, 1906; SIR JOHN I. THORNYCROFT, LL.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Anderson, Charles Goldsborough, Oratory Studios, 16, Fulham-road, S.W.
Blake, Henry D., The Limmer Asphalte Paving Company, Ltd., 2 Moorgate-street, E.C.
Karandikar, Raghunath Pandurang, High Court Vakil, Satara, Bombay, India.
Mahtab, Bijoy Chand, Maharaja Dhiraj of Burdwan, The Palace, Burdwan, Bengal, India.
Mason, Alfred W., 21, Queen-square, W.C.
Meads, Charles James, Bel Air, Dartmouth, Devonshire.
Webb, Alfred H., Los Salidos, Linares, Prov. de Jaen, Spain.
Whitcombe, Algernon Henry, 11-12, Clarence-street, Cheltenham.
Wood, Hon. Josiah, Sackville, New Brunswick, Canada.

The following candidates were balloted for and duly elected members of the Society:—

Cross, Miss Margaret, Oakbraes, Godalming, Surrey.
Gregory, Henry Kenyon, Norfolk-house, Stuart-road, Grays, Essex.
Robertson, Rudolph Alexander, Thanai Tea Estate, Dikom P.O., Assam, India.
Salomon, Frederick, 12, Canning-street, Liverpool.

The paper read was—

MOTOR BOATS.

By BERNARD B. REDWOOD.

The term "motor boat" is generally applied only to a vessel propelled by the agency of the internal combustion engine, and it is in this sense that I propose to treat the subject. This paper might perhaps have been more accurately described as "An attempt to emphasise the possibilities of the internal combustion engine for marine propulsion," but the shorter title is quite explicit. The subject is one of considerable magnitude, and with the time I have at my disposal, it will only be possible briefly to describe and illustrate the salient features, and to outline the development of motor boating as a sport and pastime and for commercial purposes.

Some of the earliest motor boats in use in this country were those supplied and engined by the Daimler Motor Company, Limited, of Coventry, in 1897. The engines had two cylinders, were constructed in England from designs by Herr Gottlieb Daimler, and the explosive charge of petroleum spirit and air was ignited by being compressed into a platinum tube heated to a cherry red.

Daimler is generally considered to have been the first man to produce an internal combustion engine suitable for road vehicles and for marine propulsion. Born in 1835 at Schorndorf, in Würtemburg, he exhibited a keen interest in mechanics from his youth upwards, and made them his constant study. He was first employed at a gun factory in Alsace and afterwards at a steam locomotive works in Manchester, finally becoming assistant to Dr. Otto. It was after Daimler had joined Otto that the latter produced the now famous "Otto" gas engine, although it is not claimed that Daimler took part in the invention of it. In 1886 Daimler fitted a launch with an internal combustion engine, and took eleven persons for a voyage on the lake at Canstatt. The engine of this boat had a single cylinder, and developed about one horse-power. It was from the design of this motor that De Dion evolved the high speed engine fitted to his early tricycle. The second launch engined by Daimler in 1887 had a motor of 4 horse-power, which differed from that fitted to the first launch in that it had two cylinders, inclined together at an angle of about 15°, working on a common crank, and was known as the "V" type. This type of engine was first constructed by Daimler in 1886, being then fitted to a road vehicle. It

was first publicly exhibited at the Paris Exhibition of 1889.

It is generally conceded that Mr. G. Priestman was the first in this country to equip a boat with an internal combustion engine. Priestman's launch was running in 1888. In 1891, Mr. J. D. Roots fitted a launch with an internal combustion engine, and apparently achieved considerable success, as this boat was running between Richmond and Wandsworth with great regularity during the seasons of 1891 and 1892. Credit must also be given to Mr. F. Lanchester, the designer of the well-known car of that name, for the design and construction of a motor vessel in the year 1895. This was a stern wheel launch or motor punt, and was fitted with a single cylinder tube ignited motor. The speed was from four to five miles per hour. In 1897 Lanchester designed another motor boat, which was fitted with a two cylinder balanced engine similar to his car type, driving a reversible propeller. This boat is, I believe, still in existence.

The engines of the English Daimler launches of 1897 had two vertical cylinders and gave about 6 horse-power. This type of engine may be said to represent continental practice of that date, having been evolved from the old "V" type of 1889. The petrol was fed by air pressure to a large surface carburettor and also to an auxiliary tank which supplied the burners for heating the ignition tubes. This air pressure was obtained by means of a small hand pump which had to be operated at short intervals. Reversal of the propeller was effected by means of two bevel friction wheels which were situated athwartships and engaged with two larger bevel friction wheels, the intermediate shafting being temporarily disconnected for this purpose. These friction wheels, which were covered with a composition of leather and rubber, proved most unsatisfactory for marine work, being adversely affected by moisture and sea salt. The original English Daimler engines were, however, well designed and built, and when fitted with spray carburettors and electric ignition performed satisfactorily.

This type of engine remained in vogue for some considerable period in this country in spite of the ever present danger associated with the use of hot tube ignition. I well remember the many exciting flare-ups which were the invariable accompaniments to a pleasant afternoon's run on the river. In America, however, the motor boat had already assumed a position of considerable importance, an apparatus for electrically igniting the explosive charge having been adopted. I may mention that it is a matter for surprise that hot tube ignition, with its obvious disadvantages for marine work, ever gained a footing in this country, especially in view of the fact that the earliest commercially successful gas engine designed by Mr. Lenoir and constructed in 1860 was fitted with a device for electrically firing the charge. As in this engine no attempt was made to secure compression of the gaseous mixture, no particular care was taken to "time" the spark. In a description of this engine by the makers, we read that "As the piston advances it draws in an explosive mixture of gas and air. About mid-stroke this was ignited by an electric spark." In 1888 Benz used electric ignition for the engine of his motor car, and in 1901 Mr. G. Priestman in this country employed it for marine work. A very simple means of electrically firing the charge and accurately timing the spark was adopted for the early American motors, a primary battery and primary coil alone being employed.

The diagram, Fig. 1, will make this clear. A is a handle or lever capable of being set at any point by notching or by screw and nut. The lower extremity of this handle-bar or lever has a hinged rod extension which engages in a tooth, C, which can be run along the quadrant of the rod, D. This tooth is struck by the cam, B, once in each revolution, at the same time driving the rod, D, backwards (against the pressure of the spring, E) and causing the boss, H, of the plunger, D, to wipe against the platinum tip, G, of the ignition plug, F. Directly the spring returns the rod a spark is produced between G and H, owing to the "break" which then occurs in the circuit between the battery, J, and the coil, K, at the point, G, H. It is obvious that the time of this "break" can be varied by shifting the tooth, C, in the manner described. The platinum point, H, must, of course, be insulated from the point, C. This is known in America as a jump spark apparatus. I mentioned that an electrical spark was caused to appear at every revolution of the engine. The reason for this is that these early American motors had no reciprocating valves, and worked on what is known as the two-stroke cycle system. In this form of engine the whole cycle of operations, viz. (1) suction of charge; (2) compression of charge; (3) ignition of charge and working stroke; (4) ex-

haust; is completed in two piston strokes or one revolution of the engine.

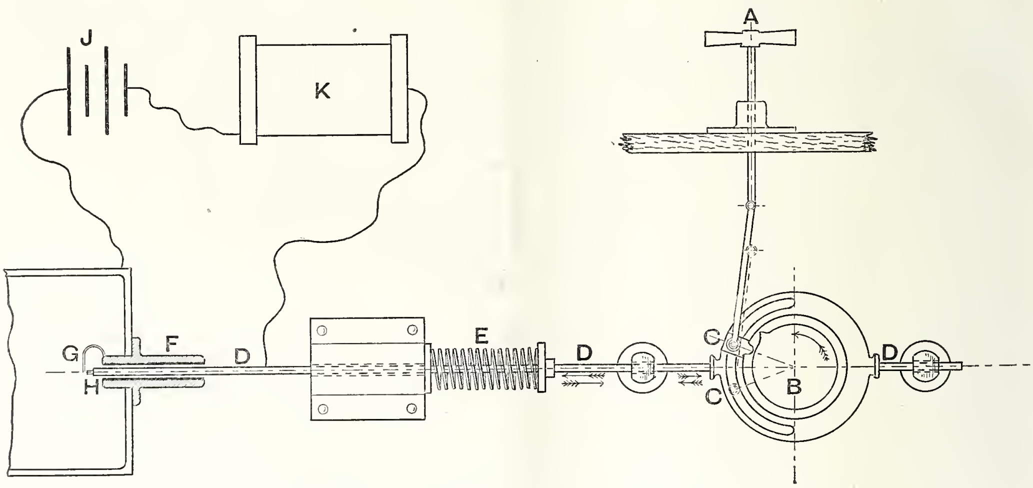
In order to effect this, mixture of the petrol and air takes place in the crank chamber, which must be gas tight, and the charge is then admitted to the combustion chamber through a port in the cylinder wall which is uncovered by the passage of the piston. The exhaust gases are disposed of in a similar manner.

In spite of the fact that boats fitted with these American engines were imported into this country in large numbers, and were sold at very low prices, the type never secured any lasting popularity, and we now almost exclusively employ for the purposes of marine propulsion, engines constructed to work on the four stroke or Beau de Rochas cycle, a type which is familiar to everyone as an ordinary motor-car engine. The inauguration of motor boating in this country as a sport and pastime, and also tentatively for commercial purposes, may be said to date from the employment of a trustworthy system of electric ignition of the explosive charge.

There are now a vast number of devices for effecting this, and the time at my disposal will not allow of a review of all of them, but I may say that one of the most trustworthy is the Simms-Bosch low tension magneto-machine. This apparatus was perfected and introduced into England by Mr. Frederick R. Simms in 1898, and in its most common form, consists of three permanent horse-shoe magnets bestriding the pole pieces, the armature being fixed. The magnetic field is cut by a rotating and in some cases by an oscillating shield, and the ignition of the charge in the cylinder is effected by a mechanical breaker in the combustion chamber. In some types of this apparatus the armature is constructed to revolve. I have used these machines in all conditions of weather and consider them the best adapted for the purpose, being extremely reliable in sparking, requiring little attention, and above all there being with them small risk of external sparking through short circuiting, the latter a most important feature in a boat employing petroleum spirit as a fuel.

Towards the end of the year 1902, great activity began to be discernible in the marine motor industry (it must be remembered that in every case I am employing the word "motor" in its restricted sense), for it was about this time that the British and continental motor-car manufacturers began to turn their attention to motor-boat construction. In the majority of cases these manufacturers were possessed of little or no experience of marine work, and were evidently of opinion that it was only necessary to put an automobile engine into a hull in order to produce a highly successful motor boat. The engines available for this purpose were, at the time, particularly in this country, rapidly undergoing a process of evolution, and were scarcely to be considered satisfactory for road work. When, however, they were installed as marine engines, the troubles were intensified. Mostly of the single or two-cylinder four-stroke cycle type, badly balanced, and frequently recklessly overloaded, they performed fairly well on road vehicles,

Fig. 1.

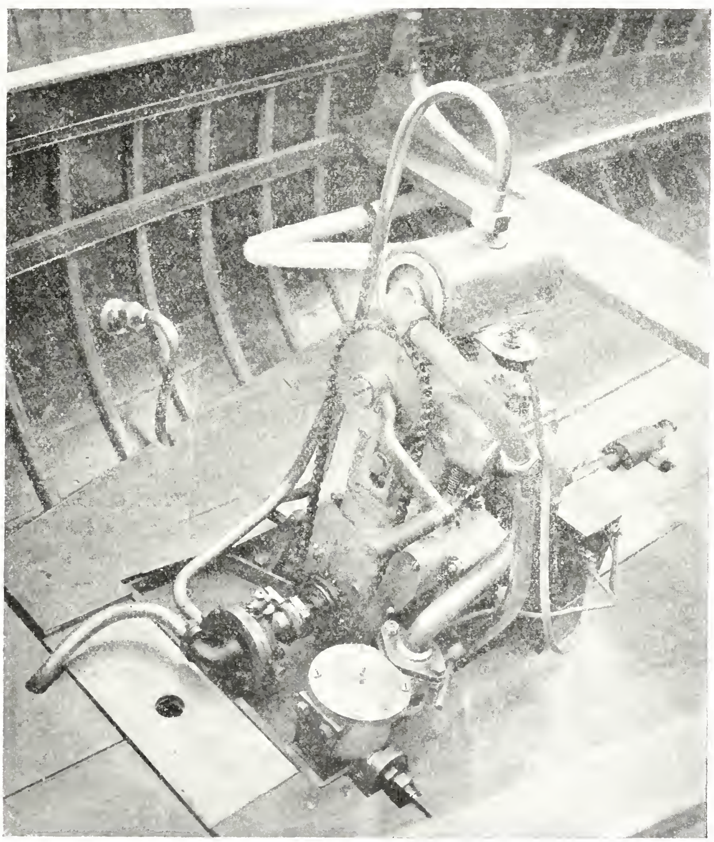


American "Jump Spark" Apparatus.

where the driver had several ratios of gearing to fall back upon, where the cylinder jackets and radiators were exposed to a cooling draught, and above all where the unbalanced vibrations of the engines were absorbed by spring suspension. When installed in a hull, however, these engines were usually worked at constant, and in some cases at an overload, circulating pumps were found to be too small, or, if large enough, the cylinder water jackets were then inadequate; vibration was constant and excessive, being usually transmitted to and magnified by the hull structure, and the general details of installation, more especially the electrical ones, were found to be quite unsatisfactory for marine work. Moreover, a considerable portion of the structure, including the crank chambers, and also many of the fittings were made of aluminium, a metal which is quite unsuitable for marine work, owing to the corrosive action exercised upon it by sea water, and even by damp air.

The accompanying illustration (Fig. 2) presents a very good illustration of this type of installation. In this case the little single cylinder four-stroke-cycle car engine has been dumped down in the hull, no protection from weather having been provided. The wiring is exposed, the high-tension wire in particular resting gracefully on the hot exhaust pipe, the whole weight being taken by the sparking plug. The carburettor is inaccessible and dangerously placed in case of overflow, being so close to the skin of the boat that no overflow receptacle can be introduced. The crank chamber and all fittings are of aluminium, and I can assure you the vibration was awful.

Fig. 2.



Type of Unsatisfactory Installation.

It was speedily recognised that special methods of construction would have to be employed if the internal combustion engine were to be rendered satisfactory for marine propulsion.

Several eminent firms, such as Messrs. J. I.

Thornycroft and Co., Ltd., and D. Napier and Sons, to mention only two instances, began to turn their attention seriously to the industry. As an outcome of this development a cup was offered by Lord Northcliffe, then Mr. Alfred Harmsworth, for international competition, the contest to be confined to boats of a maximum overall length of 40 feet, built and engined in the country which they represented, no other restrictions being imposed.

In 1903, the first race for this cup was held at Cork, there being three competitors. It was unfortunate that time did not permit of any foreign entries, although it is true that a Mercédès launch actually did come over, but was ineligible to compete, as the hull was constructed in France and the engines in Germany.

It was decided to race for this cup in heats, as it was thought by several members of the committee that the wave-making of these fast launches would be excessive and would preclude the possibility of many competitors racing together. This supposition has, of course, been shown to have been based on a fallacy, a well designed hull making very little wash, even at a speed of over 20 knots. It may be remembered that *Napier I.*, designed by Mr. Linton Hope, and engined by Napier, was the only 40-footer taking part in the contest. This boat was the first of a series of racing launches engined by Napier and Co., and presents many interesting features. The hull was built of 20 gauge steel, there being no keel but two longitudinal girders were fitted extending from stem to stern, which also served as engine bearers. The engine was a four cylinder Napier motor giving about 66 b.h.p. The design was immensely rigid, all four cylinders being contained in one casting. This rigidity of design without doubt contributed largely to the successful performance of the boat.

The best speed ever shown by *Napier I.* was 18·8 knots while running at Cowes. The other competitors were two 30-foot launches. One was the *Durendal*, designed by Mr. E. Wort, and engined by the Motor Manufacturing Company, of Coventry, with an 8-cylinder engine reported to develop 50 horse-power. The method of hull construction of this boat is interesting. She was built by Saunders on his now well-known system of three or more skins of mahogany sewn together with copper wire. The other entrant was the *Scolopendra*, constructed of wood by F. Maynard, of Chiswick, and engined by Thornycroft and Co., with a 4 cylinder motor developing 20 horse-power.

Considering her low horse-power, the *Scolopendra* was undoubtedly the most efficient boat in the competition, easily making 15 knots. The course for this race was laid in Cork Harbour, and was 7·8 sea miles in length. The *Napier* ultimately won the cup, accomplishing her heat and the final at a mean speed of 18 knots.

In 1903 was introduced for the first time in our waters motor-launch racing on a regular organised basis, with recognised rules for measurement, rating, and time allowance between different boats. I may say that launch racing had been popular for some considerable time in America, the favourite propulsive agent being petrol, both used in an internal combustion engine and instead of water in a steam-jacketted boiler, and thence conveyed to an ordinary steam engine.

Early in the year 1903 the Marine Motor Association was started, and, after collecting all the information possible, it formulated its rules for assessing the power of motors—or "motor power" as it was termed by this body—and thence ascertaining the rating of the boats. It may be remarked that the American Power Boat Association which was started some months later, practically adopted our rules for motor power, and rating with but few modifications.

Some years previously Messrs. Simpson, Strickland and Co., of Dartmouth, South Devon, had constructed a steam launch, 30 feet in length, concerning the speed of which extraordinary rumours were rife. In 1901 I had a short trip in this boat. The engine was one of Cross's patent balanced 4-crank triple type, running at about 1,200 revolutions. Steam was supplied at 380-lb. pressure by a water-tube boiler. The indicated horse-power was, I believe, about 150, and the total weight of machinery must have been very great, as the hull, though very full bodied, was deeply immersed.

It was hoped that this boat would put in an appearance at the races which were held in 1903, but she did not materialise. This was unfortunate, as we have in consequence no comparative data of the running of speed steam launches with those fitted with internal combustion engines. On the face of it the advantage is all with the internal combustion engines, and the following comparison of the respective weights given to me by Messrs. J. I. Thornycroft and Co. in 1903 serves to illustrate this.

The weight of a 20 b.h.p. Thornycroft

internal combustion engine, complete with reversing gear, batteries, &c., and petrol sufficient to take the boat 60 miles was 5 cwt. A 20 b.h.p. double acting condensing steam-engine and boiler complete would weigh about two tons, and the weight of coal and water sufficient to last 60 miles would amount to 1 ton 3 cwt., making a total of 3 tons 3 cwt., or twelve times the weight of the petrol engine and fuel.

Of course, it is possible to build steam-engines of less weight. Simpson, Strickland and Co. must have done so in order to get the amount of power they have into a 30-foot boat, but the advantage in weight would still remain on the side of the petrol engine.

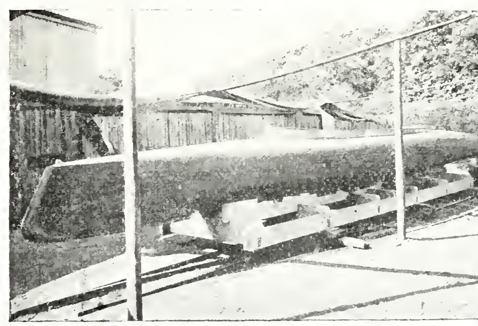
In the year 1904 the interest in motor boats became more general, and many race meetings were held.

The most important event of this year was the first of the annual reliability trials for motor boats organised by the Automobile Club through its Marine Motor Committee, which was formed in 1903 at the suggestion of Sir Boverton Redwood. This "reliability trial" was intended to be an endurance test chiefly for cruising boats, and consisted of two days running under observation, the duration of the daily run being 10 hours. A large number of entries was secured, and the contest was undoubtedly of great benefit both to manufacturers and users. The title of the Harmsworth Cup was in this year altered at the request of the donor to that of the British International Cup, and the race for this trophy created great interest. France challenged with *Treflé-à-Quatre*, *Gardner-Serpollet* and *Clement-Bayard*, and America with *Challenger*.

The rules provided that only three boats were to represent any one country, and as there were five British defenders for the cup, it was necessary to hold an eliminating race for them. One of the entrants for this was *Napier-Minor*, a 35-foot boat built by Saunders on his patent system, and engined by Napier with a 4-cylinder 80 b.h.p. motor. This engine was of the same type as that installed in *Napier I.*, possessing immense structural strength. The second entrant for this race was *Napier II.*, built of steel by Yarrow and Co., who from this time forward took an active interest in the industry. As a matter of fact, the hull of *Napier II.* proved somewhat unsatisfactory, and another was put in hand. Messrs. J. I. Thornycroft's *Champak* and Lord Howard De Walden's *Fer de Lance* never materialised, so that *Hutton I.*, the fifth entrant, was left to walk over the course, which she did not succeed in doing.

Hutton I. was a remarkable vessel, and possessed every feature requisite for high speed, with the exception of an engine that could be started, or when started could be kept running. The hull was a very pretty one, designed by Linton Hope, and constructed by Hart, Harden and Co. of mahogany carvel. The accompanying illustration, Fig. 3, gives a good idea of

FIG. 3.



HULL OF "HUTTON I."

her design, which at that time was quite novel, and at any period might justly be described as an extreme type. It can be seen that the hull was cigar-shaped, and consequently possessed great strength, although the weight was only 6 cwt. The engine of *Hutton I.* was a 6-cylinder one of fearful and wonderful design. There were two inlet and two exhaust valves for each cylinder worked by a hinged overhead rod. These valves, I may say, were originally designed to have their heads secured to the stems by means of ball and socket joints. The water jackets were separate from the cylinders, and were secured to a flange on the cylinders. Structural weakness of crank chamber and of valves, preignition due to high compression, faulty carburation and inefficient water circulation were among the causes contributing to the non-success of this engine. Of the French boats only *Tréfle-à-Quatre* and *Clement-Bayard* came over, and the latter was early in trouble and never started. *Tréfle-à-Quatre* was credited with being at that time the fastest motor boat in the world. She was only 30 feet $2\frac{3}{4}$ inches in length, and was equipped with a Richard-Brasier motor of about 60 horse-power. Previously, during the Monaco races, she covered $124\frac{1}{2}$ miles at an average rate of $23\frac{1}{2}$ miles per hour. The American boat,

Challenger, was built and engined by Smith and Mabley, and presented no extraordinary features. The final heat of this race was won by *Napier-Minor*, but the cup was awarded to *Tréfle-à-Quatre* on a technicality.

In 1905, such was the growth of the industry that the Marine Motor Committee of the Automobile Club found that they were quite unable to cope with the situation, and accordingly the Motor Yacht Club was formed to carry on the work relative to the reliability trials and the British International Cup, both of which events had been previously organised and conducted by the Marine Motor Committee of the Automobile Club. A large number of entries were received in 1905 for the reliability trials, one firm, Messrs. Thornycroft, entering no less than five boats. The accompanying ilustration (Fig. 4) shows the whole fleet of entrants preparing to start from No. 4 Graving Dock at Southampton. Steamboats were admitted for the first time in 1905, and the smoke from the funnels of the only two vessels of this type can be plainly discerned.

In an early part of this paper I referred to the friction reverse gear fitted to the English Daimler launch engine of 1897, and explained how satisfactory the composition-lined clutches proved in use. It is now customary to employ for the purpose of reversing the direction of the propeller some positive device such as the type of gear which is employed for motor cars, in which reversal is obtained by means of the introduction of a gear-wheel train which is ordinarily idle.

The most interesting vessel entered by Thornycroft and Co. for the reliability trials was the *Emil Capitaine*, a type of harbour launch propelled by an internal combustion engine of 75 b.h.p., employing producer gas as a fuel. The engine of this vessel was of the vertical enclosed type, having four cylinders, each $8\frac{1}{4}$ inches diameter by 11 inches stroke, and running at 300 revolutions per minute, gives about 75 b.h.p. The inlet and exhaust valves are all mechanically operated, the cam shaft being placed above the top of the cylinders and slightly out of the centre line, the valves being actuated by means of rocking levers. The cam shaft is hollow and carries in it a sliding shaft which, by means of radial arms projecting through slots in the cam shaft, operates the low tension ignition strikers. The longitudinal motion of this inside shaft, which

Fig. 4.

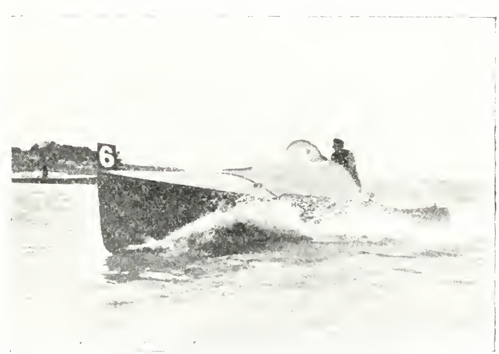
Fleet of Entrants for 1905 Reliability Trials.

is controlled by the governor of the engine, varies the time of ignition, advancing it as the speed of the engine increases. Arrangement is provided whereby the timing of the magneto machine is simultaneously varied to correspond with the point of ignition. The engine is controlled by means of a throttle valve in the induction pipe connected by a special arrangement to the governor. There is besides provision for completely cutting out the electrical circuit when the speed of the engine exceeds a certain limit. Half compression gear is provided for starting the engine, which is done by a separate 6 horse-power Thornycroft motor through the medium of a belt. The half-compression cams are automatically thrown out of action by means of an attachment to the governor, when the engine is running at normal speed. A centrifugal pump, driven off the engine, is provided for supplying cooling water to the combustion heads and cylinder jackets. The exhaust is also water jacketed, and the gases are discharged up a funnel, no silencer being required. A reciprocating oil pump of special design is provided for forcing oil in turn to all bearings. Special provision is made to facilitate the cleaning of the cylinders, valves, &c., and a peculiar feature of the engine is that although the combustion heads are separate from the cylinder barrels, yet the explosive strain on the combustion heads is not taken by the connecting bolts but by the whole framework of the engine. Doors are fitted in the lower part of the engine casing to provide access to bearings, &c.; at the forward end of the crank shaft is a pulley for driving a gas drier and a centrifugal pump for pumping the heated and dirty water from the gas purifier. The gas producer is of the ordinary cylindrical shape. It is lined with fire-brick, and has three charging-doors in the top, which deliver into a conical annular hopper. A fire-grate, and air and steam inlets are provided in the lower part, as usual. A special feature of the gas-producing plant is the arrangement for drying and purifying the gas without using any solid material in the scrubber, as is usual.

The 1905 eliminating race to decide the British team for the International Cup race was held at Seaview, Isle of Wight, and there were five entrants. One of these was *Hutton II.*, a new racer very similar to *Hutton I.* which I have already described in detail. The engine was in fact the same with a few details improved and strengthened, and the hull was very similar, but of slightly greater displacement. *Hutton II.*, however, broke down before the start. The fastest competitor on paper was *Brooke I.*, designed by Shepherd, and built and engined by Brooke and Co., of Lowestoft, with a 6-cylinder engine, each cylinder being 10 inches in diameter. This boat never ran satisfactorily, owing, it was said, to the difficulty of maintaining a requisite supply of petrol for the huge engine. Another entrant was *Napier II.* The hull of this boat was built by Yarrow and Co. of steel, being an improvement on the previous year's boat of the same name. Two 4-cylinder 80 horse-power Napier engines, driving twin screws, were installed.

On this boat a raised seat for the helmsman is provided right aft and is protected by a dodger. It has been found by experience that

Fig. 5.



"Competitor."

it is preferable to steer these fast small boats from aft, and I have found from personal experience that some form of protection from the flying spray is very necessary. This spray constitutes the chief drawback to motor-boat racing as an amusement, and as its velocity is very high, the impact is most unpleasant. The general sensation of driving a motor boat is very reminiscent of a stroll beneath Niagara Falls, with this difference, that in the former case you are unable to gain relief by shutting your eyes, as it is necessary to keep a sharp look out. The fourth entrant was *Napier*, owned by Lord Howard de Walden. The hull was built by Saunders on his patented system which I have already described, and the engine was the old 80 horse-power Napier motor taken out of *Napier Minor*.

The other entrant was the *Competitor*, owned by my friend, Commander Mansfield Cumming, R.N., and in it I had the pleasure of racing.

The hull may be easily recognised in the photograph (Fig. 5) as that of the old *Napier Minor*, and the engine was a 100 horse-power Siddeley, constructed by the Wolseley Tool and Motor Car Co. In this race, every boat except *Napier II.* broke down, and it was decided to hold another eliminating race in the Southampton Water for *Napier*, *Brooke I.*, and *Competitor*. In this race, *Napier* finished first, *Competitor* second, and *Brooke I.* broke down. Ultimately *Competitor* relinquished her place in the team in favour of *Brooke I.*, as it was thought that the latter could be got into racing condition in time for the Cup race, which was to be held at Arcachon.

France showed extraordinary apathy over this contest, and it was only by the energy of a few private owners, that a semblance of defence was made with cruising boats. The Cup was ultimately won by *Napier II.*, which had run well and consistently throughout the season, only having lost the cross Channel race by an error of her helmsman in passing the finishing mark on the wrong side.

The highest speeds attained by racing vessels in 1905 were 25·75 knots by *Napier II.*, and 25 knots by *Hutton II.*, during a short trial run. Recently during the present year a 40-foot launch named *Legru Hotchkiss* has attained the enormous speed of 29·65 knots during a run of 10 minutes. The hull of this vessel was designed by Linton Hope in 1904, and she was built on the Saunders's system. Many motors have been installed, but the present engine with which the record run was accomplished is an 8-cylinder Hotchkiss of 170 b.h.p. In order to show how weight per horse-power of internal combustion engines for racing has been reduced, I will take three examples, the 66 b.h.p. engine of *Napier II.* in 1903 weighed 25·5 lbs. per horse-power. In 1904-5 the engines of the fastest boats weighed some 24 lbs. per horse-power, while in the present year the Hotchkiss engines of *Legru Hotchkiss* weigh only 14·9 lbs. per horse-power. These weights, I may say, represent the total engine equipment including all gear. In order to provide for handicap racing, and with a view for this purpose to place, as far as possible, boats of all sizes and powers on more or less of an equal footing, the Marine Motor Association in 1904 framed a rating rule, the following being the formula:— $\frac{P \times L}{A} = R$ where $P =$ the motor power. This latter is assessed by multiplying the area of the pistons in square inches by the stroke in feet, and again by the revolutions and dividing by a constant, which in the case of a 4-stroke cycle engine = 1,000 and of a 2-stroke engine = 600. $L =$ length of the boat over all, and $A =$ area of immersed midship section at point of greatest beam. This formula worked admirably with boats of small power, but taxed high powers too heavily. As an instance, I may mention that *Napier II.*, with a horse-power of 160 and an actual speed of 25·75 knots, would have had to travel at 42·35 knots in order to win under this rule. At the suggestion of Mr. Linton Hope this formula was altered to read $\left(\frac{P2}{A}\right) + \sqrt{L} = R$ the several values remaining identical with the exception that the immersed sectional area was measured at a distance = ·6 of the vessel's length measured from the bow, as it was found extremely difficult in practice to ascertain the point of greatest beam accurately. Moreover, an extreme type of vessel might when at rest carry her greatest beam right aft, the whole sectional area at that point being clear of the water. This second formula has been found to work admirably.

The majority of engines described in this paper have been of the four-stroke cycle type, and I mentioned that the early American two-stroke cycle engines when introduced into this country secured no lasting popularity. This was largely due to their inherent faultiness of design. I explained that mixture of the petrol and air took place in the crank chamber, and was then admitted into the combustion chamber by a port in the cylinder wall which was uncovered by the passage of the piston. The exhaust port was uncovered in a similar way, but an objectionable feature of this type of engine was that if the revolutions were at all high, and even sometimes when they were not high, a charge which was still burning would find its way out, not through the exhaust port, but through the inlet. The result was a considerable explosion in the crank chamber, which, if it did no damage, pulled up the engine short. Frequently too, these engines would reverse of their own accord, and I know of one that is running at present, which can never be depended upon to start in the right direction. In fact more often than not it runs backwards. There are, however, several two-stroke cycle engines which are designed so as not to possess these faults, and one is the Mietz and

Weiss. In this engine the system is adopted of aspirating and compressing air only into the crank chamber. This air is admitted in the usual manner to the combustion chamber, the fuel being sprayed in by a mechanical device. The incoming charge of pure air assists moreover in scavenging the cylinder of the products of combustion.

This engine differs from all other two-stroke motors in that the fuel is mechanically introduced separately from the air.

The initial compression in this engine being very high, ignition is automatic, no separate ignition system being employed except for starting. A different system is adopted in the Körting engine. The air is compressed, and thereby warmed in special receivers by means of pumps, and is then admitted to an ordinary form of spray carburettor, there being one for each cylinder. In this engine a departure from ordinary practice is made by the introduction of piston rods and crosshead guides. This is done with a view to eliminate side thrust on the cylinder walls.

Most of the engines which I have described employ petroleum spirit as a fuel. This petroleum spirit, or petrol, as it is termed, usually has a specific gravity of from ·680 to ·700, and gives off inflammable vapour very freely at ordinary atmospheric temperatures. It is obvious, therefore, that special care must be exercised in its use, and in consequence a great deal of thought has been applied to the problem of producing an apparatus for employing ordinary kerosene, and even the heavier oils as fuel for these engines.

The usual method of preparing kerosene for use in an internal combustion engine is to inject it into a chamber which it is heated to a dull red, where it vaporises, and then to mix it with air and pass it into the cylinder. One of the earliest engines of this type was the "Priestman." One of the most excellent modern kerosene launch engines which operate on this system is the "Seal," a peculiarity in the design being that the cylinder is inverted, the centre of gravity being thereby brought very low. A preliminary heating of the vaporiser is all that is necessary with this motor, as the heat of the explosions maintains the temperature of this automatically as long as the engine is running. The Hornsby engine is an example of a type of engine fitted with vaporisers adapted for employing the heavier classes of oil.

The great objection to the employment of vaporisers is that with them dissociation of he fuel is liable to take place with an accompanying deposit of carbon which is liable to choke everything up. To overcome this difficulty many so called atomisers have been devised, the object being to break up or atomise the fuel and mix it with air, thereby forming an explosive mixture without having resort to fore-warming. An ingenious device of this kind is the Bryant and Watling carburetter.

The question of the application of the internal combustion engine as auxiliary power for our fishing fleets is now arousing a great deal of interest. Of course, for this purpose, the employment of petrol as fuel is, on account of its dangerous character, undesirable. The first fishing boat in this country to be fitted with an internal combustion engine was, I believe, a Lowestoft vessel, named *Pioneer*, and the motor was a 4-cylinder 2-stroke cycle one of American manufacture. This was installed in 1902.

Nothing else seems to have been done in this direction until last year, when Commander (then Lieutenant) Mansfield Cumming, R.N. was commissioned by the Scotch Fishery Board to select a suitable motor for installation in a Fifie herring drifter.

The dimensions of this type of fishing boat, are—Length o.a. 72 feet; l.w.l. 71 feet; beam 21 feet; depth, 8 feet. One of these boats has under sail covered 22 nautical miles in less than two hours in a hard breeze. The price of such a vessel amounts to about £700. It was estimated that her speed with a motor developing about 20 b.h.p. would be five knots. The engine selected by Commander Cumming was the "Dan," made by Messrs. Jorgensen, of Copenhagen. This was a 2 cylinder motor of 25 b.h.p. The design was somewhat crude, but admirably suited for the work.

The "Dan" engine works on the 4-stroke cycle system, and employs kerosene as fuel by means of a vaporiser. This engine has proved very satisfactory throughout the past season, only one breakdown having occurred, and this was caused through the carelessness of one of the crew. I may say that this vessel was also named *Pioneer*.

The present idea prevalent among the fishermen is that the speed of the *Pioneer*, viz., 5 knots, is not great enough, but it must be remembered that her entire installation, including a capstan, only cost £350, and it is impossible, without expending a prohibitive amount, to get much more speed out of the full-bodied Fifie drifter.

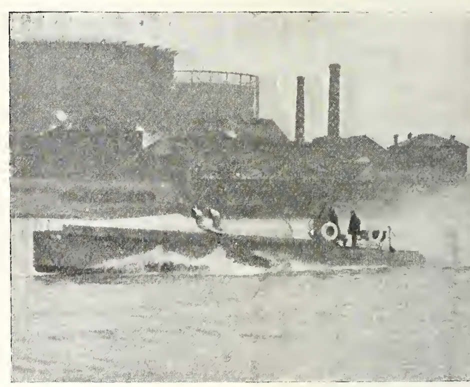
Probably the most efficient internal combustion engine employing heavy oil as fuel is the Diesel, but, owing to its massive construction rendered necessary by the enormous initial compression required, it has been found to be very heavy for marine work, although I have heard that engines of this type have been installed in some barges belonging to the Standard Oil Company in America, and are performing satisfactorily.

The Diessel engine works on the 4-stroke cycle, and the fuel generally used is the residue after distillation of the lighter spirits and oil from the crude petroleum as obtained at the wells. Almost any sort of cheap oil can, however, be employed as well as kerosene. In one case I have heard of, Diesel engines are running satisfactorily on a mixture of nut and palm oils. The cycle of operations is as follows:—Air is compressed and thereby heated to 1,000° Fahr. in a two-stage compressor and is then drawn into the cylinder, a measured quantity of fuel being gradually injected into this hot air in the form of spray during a greater or less portion of the working stroke, while the compressed air is expanding at constant pressure. The gradual combustion thus obtained is essentially and exclusively part of the Diesel cycle and marks in itself the fundamental difference between this and all other internal combustion engines.

Several lifeboats round our coasts have now been fitted with internal combustion engines and are performing most satisfactorily.

Ever since the *Gregory*, the first torpedo boat to be fitted with internal combustion engines, crossed the Atlantic under her own power, a great deal of interest has been aroused concerning the possibilities of such craft. The *Gregory*, it will be remembered, was supposed to be the first of a fleet of twelve motor torpedo boats ordered by the Russian Government, and was built by the Standard Boat Co. of New Jersey. It is reported that the remainder are now being reconstructed in the dockyard at St. Petersburg under the supervision of Mr. Lewis Nixon, formerly chairman of the United States Shipbuilding Co. It is also said that the order for the boats was conditional upon the *Gregory* crossing the Atlantic on her own bottom, which, after many attempts, she succeeded in doing. In this country, Messrs. Yarrow and Co., of Poplar, have this year launched a remarkable vessel. This is a motor torpedo boat No. 1176 which is shown in the accompanying illustration (Fig. 6), while travelling at 26 knots. 1176 is built of steel, and is of exactly the same dimensions as a second-class torpedo boat, viz., 60 feet in length, by 9 feet beam. She is provided with five engines, each having four cylinders. These engines were designed by Napier and constructed by Yarrow, and are known as the K5 type. The cylinders are 6½-inch diameter and 6-inch stroke, and each engine develops 80 b.h.p. at 1,080 revolutions per minute. These five engines are installed so as to drive three propellers. The starboard and port propellors are each driven by two engines, and the centre propeller by one. It is interesting to compare the weights of machinery of 1176 with the weight of steam machinery ordinarily installed in second-class torpedo boats, and which is supposed to be extra light. I have the following figures from

Fig. 6.



Yarrow Motor Torpedo Boat No. 1176.

Mr. Yarrow himself so that they may be taken as quite accurate. The total weight of steam machinery of a second-class torpedo boat amounts to 5 ton 5 cwt., the i.h.p. is 300, and the best speed 20 knots. The total machinery weight of 1176 is under 3 tons, the i.h.p. considerably over 300, and the best speed 26 knots. I think you will agree that this is a remarkable performance. Mr. Yarrow told me that he attributes this result partly to decreased displacement, and partly to the design of the hull, which is extraordinary. I may add that the displacement of a second-class torpedo boat is 11 tons, and of 1176, 8 tons. The exhaust from all five engines is taken through a non-return valve straight under water amidship, and I am assured that no back pressure is experienced.

There are many ways of dealing with the

exhaust gases from an internal combustion engine without discharging them straight into atmosphere, in which case the atmospheric pressure has to be overcome, but I am afraid time will not permit of a description of these, but I must just refer to the Rankin-Kennedy exhaust ejector. In this device water is injected into the exhaust pipe in such a manner that the exhaust gases are cooled and consequently reduced in volume and are discharged silently with the water.

It will be noticed that the engines of 1176 have 20 cylinders in all, and the complication attendant on such a mass of units has been adversely criticised. As a matter of fact this is where the limitation of the internal combustion engine in its present form is felt. When large units have been experimented with great trouble has been experienced and water cooling of pistons has been found to be necessary. It is reported that the British Admiralty are using in the submarines engines having cylinder diameters of 12 inches, but this seems to be the largest size that can be used with petrol as fuel without water cooling the pistons.

With heavy oil I have heard that cylinder diameters up to 17 inches have been successfully operated without water cooling the pistons. It is possible that a solution of the internal combustion turbine problem may assist in the production of higher-powered installations, but the most eminent authority on this subject, Mr. Dugald Clerk, does not regard this solution as a probability. Mr. Dugald Clerk states that only one gas turbine has really rotated within his direct knowledge. It was designed by Mr. F. W. Lanchester, of Birmingham, to operate with the exhaust gases from one of the petrol engines used in his well-known motor cars. Mr. Clerk was assured that it really rotated at a high speed and made a loud shrieking noise, but only gave a total brake horse-power equal to that capable of being evolved by two blue-bottle flies. This power the designer did not consider to be satisfactory. The Brayton engine, constructed in 1873, was another ingenious internal combustion engine which is susceptible of development. In this motor gas was stored at constant pressure in a reservoir, and supplied to a working cylinder in which a gas jet was kept constantly burning. Backfiring to the reservoir was prevented by a provision of wire gauze in the cylinder head, and the single-cylinder motor gave an impulse every revolution.

In conclusion, I desire to thank Messrs. Yarrow and Co., Messrs. Thornycroft and Co., Mr. Linton Hope, Mr. F. R. Simms, Mr. S. F. Edge, Mr. Arthur F. Evans, and many gentlemen who have kindly lent me slides and furnished valuable data. I wish specially to thank Sir John I. Thornycroft for honouring me by taking the chair, and to thank the Council of the Society of Arts for permitting me to read the paper, and the audience for being good enough to listen to it.

DISCUSSION.

The Chairman, in opening the discussion, expressed his thanks to the author for the excellent paper he had read. Mr. Redwood had exhaustively dealt with the early history of the subject, and had placed the facts in chronological order so that his paper would be most useful for reference to the early history of motor boats. Although the early history of the subject was important, it was now more historical than anything else; and the recent practice which had been illustrated, showed that the internal combustion engine, in cases where extreme lightness was necessary, had displaced the steam engine. With regard to the comparative figures of the internal combustion engine and the steam engine given by the author, he thought the comparison was not fair to the steam engine, because the weight stated for a condensing engine was not the lightest that could be obtained. The flat form of the motor boat was a very important consideration. It was the form which Ericsson tried to make a long time ago, when he forced air underneath the ship, and somewhat reduced skin friction. He believed the very flat hulls imprisoned air, the flat surface enabling it to retain a layer occupying a considerable part of the surface; so that the very great results obtained, especially at high velocities, might be attributed to the peculiar flat form. The flat form of stern which had been found so advantageous was, curiously enough, adopted in some of the steam barges that had been made for towing in canals. The canals of the country were so small that an efficient screw could not be used in the ordinary ducts of water, so that the screw was brought to the surface of the water, a flat stern covered it and so prevented air going down and causing waste and loss of pressure on the screw. A good many years ago he was interested in the subject of obtaining the best possible touring barge for canals, and he made a hollow stern so as to force the water, by atmospheric pressure, above the level of the external water. That design was a success, and it remained a feature of the torpedo boats which his firm had built for a long time. With regard to the question of gas produc-

tion, the work which his firm had undertaken in introducing a suction gas plant had been successful, and the working of the engine had been entirely satisfactory. The only difficulty which had been experienced was in getting good gas. The producer was very efficient, and worked for a long time without attention, but occasionally a change occurred, causing trouble, the cause of which they were not able at present to fathom. The small amount of coal used by the plant was a very remarkable feature.

Mr. LINTON HOPE thought the audience was greatly indebted to the author for his excellent paper, which was the most exhaustive account of motor boats that had ever been written. With regard to the question of the tendency of design, the Chairman had just mentioned the flat hull, and he thought all who had been sailing men as well as connected with power propulsion recognised the enormous benefits that had been obtained by that form of design. The only drawback to its adoption was that as soon as a boat so constructed got into broken water it had a marvellous tendency to stop suddenly, in the sailing boat especially. He thought that accounted for the difference in the speed of *Napier II.* in an actual race at sea and on the measured mile in the smooth water of the Thames. In the latter case, she attained a speed of just on 26 knots, but he believed he was right in saying her best racing speed was only about 23 knots. That exactly bore out the experience of the Sharpie sailing boat; in smooth water she was practically unbeatable, especially in strong winds, but in broken water she had invariably been a failure. He personally adopted the line of going in for a combination of an extremely flat hull aft and a finer entrance in order to try and ease the boat through the sea. The *Treflé-à-Quatre* and *Hutton II.* were designed almost identically at the same time, the one in France and the other in England, and except in the difference in the length of beam they could hardly be distinguished apart. The *Treflé-à-Quatre* was one of the easiest sea boats he had ever seen; she hardly made any wash, and in heavy seas made no more fuss than a porpoise, a very important consideration in a sea-going boat.

Mr. SEATON EDGE thought the difference of 3 knots an hour in the speed of *Napier II.*, when tested on the measured mile, and when run at sea, was a very reasonable allowance, considering the difference in the conditions which existed in the two cases.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Redwood for his excellent paper, which Mr. Redwood briefly acknowledged, and the meeting terminated.

THE FRENCH OCTROI SYSTEM.

The Foreign Office has just published (Miscellaneous Series, No. 644) an interesting report by Mr. Consul-General Hearn on the French octroi system. The inhabitants of the United Kingdom have no experience of such a system although, until a few years ago, duties having some resemblance to foreign octroi duties were collected by the Corporation of London on coal and wine entering the City. The French octroi duties are collected solely for revenue, and fall equally on all goods that are taxed, whether native or foreign. They profess to be entirely non-protective, but they may easily become prohibitive, and do become restrictive. For example, the Customs duty on imported spirits is only 2s. 6d. per gallon, but they have to pay in addition excise duty of 9s. 1d. per gallon, and octroi duty of 2s. per gallon, in all 13s. 7d. per gallon of proof alcohol. Coal is taxed by the Havre and Rouen authorities, 4s. per ton, but the octroi tariff does not touch many articles imported from the United Kingdom. The general tariff divides the communities into six classes for the imposition of octroi duties. The first includes towns of 4,000 inhabitants and under; the second, those of 4,000 to 10,000 inhabitants; the third, from 10,000 to 20,000 inhabitants; the fourth, from 20,000 to 50,000 inhabitants; the fifth, from 50,000 to 100,000 inhabitants; and the sixth, towns having more than 100,000 inhabitants. Apparently the object of this classification, by which the dues increase with the population of the towns, is that local taxation shall be in keeping with the municipal financial requirements. In the eye of French law, octroi duties should have the following characteristics:—(1) They should fall equally on all citizens, whatever their position; (2) they should be restricted to articles of consumption within the community, because, since the tax is for purely local uses, it ought only to be paid by the inhabitants who alone reap the benefit of the municipal services. Lastly, they should weigh equally on all goods of the same nature, no matter where they come from, for towns should not have anything to do with protective tariffs, or in any way disturb the general conditions of the market.

The octroi duties have called forth at various times sharp criticism, and the problem of their suppression has been examined of late years, but the question "How to replace them," has not been satisfactorily answered. The Commission of the Senate appointed to inquire into the matter some years ago, reported that it would be impossible to entirely replace the octroi duties, and while urging that there would be great advantage in reducing the duty on certain articles, such as meat, they were obliged to confine themselves to one article only, and chose wines, with a view of increasing vine growing, which had been suffering for some years from bad seasons and crops. The consequence was the law of 1897, which prohibits the imposition in the future of duties on the beverages

styled "hygienic," *i.e.*, wines, cider, and beer, considerably reducing the taxes which communes were previously permitted to levy on such beverages, and declares, in principle, that no surtaxes will in future be allowed on these beverages. On the other hand, it allows municipalities to have recourse to certain taxes designated by name, and even to direct or indirect taxes not designated, which, with the approval of the Legislature, must be employed in reducing the taxes on "hygienic beverages," in completely suppressing the octroi on these same beverages, and, only afterwards, to the reduction of other articles. The number of octrois, which was 1,514 in 1897, had only fallen off to 1,504 in 1903, and it is hardly at this time, says Mr. Hearn, when the State appears inclined to throw upon the municipality a great portion of the new expenditure voted for obligatory instruction, public assistance, &c., that the municipalities are likely to abandon of their own free will resources which are certain, and have been consecrated by long usage, in favour of new taxes which would be probably very unpopular with the mass of the population.

Octroi duties may be collected in four different ways. The first is the "regie simple," in which the mayor directly administers the octroi with the aid of special officers. The second is the "bail à ferme," or farming lease, by which the municipality authorises a contractor to collect the duties at his own risk and peril, with the reserve that he shall conform to the regulations of the tariff, and that he shall pay each year into the municipal coffers a sum agreed upon and calculated on the estimated amount of the duties. The other two methods of collection which are authorised by law are the "regie interessée," which is nothing but a form of the foregoing mode of collection, and the "abonnement avec la régie des contributions indirectes," by virtue of which this last administration undertakes to collect the duties for the benefit of the municipality. The different systems have each their separate advantages according to the position of the municipalities. The "régie simple" allows of the collection of the duties at small cost, but requires a very active supervision which mayors are not always able to give unless they are aided by a special control service. The "bail à ferme" protects towns against variations in local consumption, and ensures their having regular incomes at fixed intervals. The "régie interessée" counteracts the inconveniences of farming, as it limits the contractor's profits by a clause in the agreement while tying him to share them with the town when they reach a given sum; but it has the disadvantage of not allowing of the definite settlement of the sum until after the expiration of the lease, so that it entails, until that time, an uncertainty as to the net revenue of the octroi, which is embarrassing to small budgets. The "abonnement avec la régie" offers considerable advantages to municipalities which tax nothing but articles paying an entrance duty, as they are able to economise not only on their staff expenses, but on those of collection and supervision. The large majority of octrois are under the "régie simple" system: in 1903, 870 out of a total of 1,504. In that year Paris received £4,350,960 from the octrois, and the Departments, £6,671,110. The cost of collection amounted to £1,210,360, of which £452,670 was for Paris. The cost of total collection was therefore 10·98 per cent., and for Paris 10·40 per cent. The sum contributed per citizen was 15s. 4½d., and per citizen of Paris £1 12s. 1d.

THE INDUSTRIAL DEVELOPMENT OF BELGIUM.

Belgium is the most densely populated country in Europe, it contains 616 persons to the square mile. At one time the country seemed destined to perpetual barrenness, as it was nothing but a dreary, silent and seemingly irreclaimable waste, composed of morass, sterile heath, and sandy desert. It has been drained by canals and ditches and converted into fertile fields that are so productive that nearly every inch of the arable soil is cultivated. Nearly all the land is especially adapted to growing wheat, rye, oats, barley and vegetables. The cultivation of tobacco, hops, dye plants, flax and hemp is carried on very extensively. The fields and meadows furnish pasturage for a vast number of horses for which the country is noted, and also for cattle and sheep. In minerals, Belgium is rich. The chief source of the country's prosperity lies in its mineral productions and manufactures therefrom. In the provinces of Hainault, Namur, Luxemburg and Liège, are found vast quantities of copper, zinc, peat, marble, slate, limestone, iron and coal, the mining of which gives employment to thousands of workmen. The savings banks contain about £40,000,000, and there are 6,000 mutual aid societies. More than 50,000 workmen live in houses built by building and loan societies. For three-quarters of a century Belgium has enjoyed peace, which has given her an opportunity for the development of her resources and for the expansion of her commerce. With an area of only 11,370 square miles, and a population of 7,000,000, she ranks fifth in importance in the world's list of industrial and commercial countries. The transportation facilities are good, and there are 1,350 miles of navigable waterways, and 2,800 miles of railways. The natural wealth of Belgium consists chiefly of rich deposits of coal, iron and zinc. In the province of Hainault there are, according to the recent reports of American Consuls in Belgium, 181 coal pits in operation, 23 in reserve, and 7 in preparation. The total production of the 181 pits in 1904 amounted to 16,152,569 tons. The number of miners employed was 99,833, receiving in wages £4,437,000. In the province of Namur 721,520 tons of coal were produced, valued at £307,000. The coal fields in the province of Liège comprise 96,500 acres of worked territory, producing

in 1904 nearly 6,000,000 tons, valued at £3,100,000. The Liège district also produced 623,437 tons of iron ore, and 122,886 tons of zinc, the value of the latter being £2,600,000. Silver and lead are also mined in considerable quantities in that district. The chief manufactures are linen, woollen, cotton, lace, leather, and metals. The principal seats of the linen manufactures are Bruges, Brussels, Ghent, and Tournay. The woollen centres are Verviérs, Liège, Dolhain, Yprès, Mons, Thuin, and Limbourg. Brussels and Tournay have large carpet manufactures, and Hainault supplies a considerable amount of hosiery. The principal manufactures of cotton are at Ghent, Bruges, Lokeren, Mons, and Antwerp. Leather and leather goods are manufactured at Limbourg, Liège, Stadelot, Dinant, and Namur. There are ordnance foundries at Liège, the largest turning out 5,000 Mauser rifles daily. The foreign trade of Belgium, according to the official returns issued by the Belgian Government, showed an increase in 1905 over 1904—the imports for home consumption last year amounting in value to £115,410,000 as compared with £106,900,000 in the previous year, while the exports of domestic produce and manufacture were valued at £87,400,000 in 1905, and £82,960,000 in 1904. The principal articles of import are grain, wool, wood, flax, mineral products, and hides and skins. The principal articles sold by Belgium to foreign markets are machinery, metals, linen and hemp yarn, wool, coal and flax.

SIXTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY, ROME, 1906.

The Sixth International Congress of Applied Chemistry will be held in Rome, commencing on April 25th, 1906. The organisation of the Congress in this country has been undertaken by the Society of Chemical Industry, and the General Secretary is the Secretary of that Society, Mr. Charles G. Cresswell, Palace-chambers, Westminster, S.W. The General Secretary will be obliged if those members, who have made arrangements directly with the Congress Committee in Rome, will forward their names to the Society, in order that arrangements may be made for a headquarters in Rome and for combined travelling. It would also be of service if they would indicate their contemplated date of departure and proposed route, and also whether they have a preference for any particular hotel in Rome. Arrangements have been made with Messrs. Thos. Cook and Son for an inclusive charge of £17 per person for the journey. This will include first-class return tickets to Rome, dinner, breafast, and luncheon *en route*; steamer trip from Como to Bellaggio and back; hotel at Como, breakfast, luncheon; hotel accommodation at Rome during seven days' stay, and minor travelling charges. The tickets are available for return at any time within 25 days.

HOME INDUSTRIES.

Canals and Waterways.—The Royal Commission on Canals and Waterways held its first meeting last week, and in due course much valuable evidence will be taken and published, and may be made the basis for legislation. There is general agreement that the improvement and development of the canal system would be to the national advantage, but it is easy to make too much of Continental example. The conditions are widely different. As the British Consul-General at Antwerp recently pointed out, the prosperity of the Belgian canals chiefly depends on the port of Antwerp, and its "practically unique position as a distributing centre for a large portion of North-Eastern Europe." On the other hand, Great Britain is an island, and not a gateway to a continent; her canals can, even in the best of circumstances, serve little more than a local purpose; the tendency more and more in Great Britain is for the traffic to move in small quantities, with quick delivery, to suit immediate needs, rather than by consignments requiring great storage, and the railway truck is thus a more convenient unit than the canal barge; while the railway can reach works or factories, or get near to them, inaccessible to canals, resort to which would involve heavy additional cost for cartage. Then, as Mr. Edwin A. Pratt points out, even if British and Continental commercial conditions were really identical, canal construction on the great level plain that stretches, with but little interruption, across Belgium and Holland and Northern Germany to the steppes of Russia, involves much less cost per mile than the reconstruction of the English canal system. For example, this work includes 92 locks in thirty-two miles of the Rochdale Canal; fifty-eight locks in sixteen miles on the Worcester and Birmingham Canal; a group of "staircase" locks with a total rise of fifty-nine feet on the Leeds and Liverpool Canal; forty-five canal tunnels, each of from one hundred to over three thousand yards in length, and canal viaducts up to a thousand feet long, on which from £20,000 to £50,000 each has been spent to adapt them for boats even of the present small dimensions. These facts suggest difficulties of construction and maintenance which go far to explain why so little has been done of late years to improve and extend our canal system. The great risks involved in reconstruction are obvious, the accruing profit not less dubious.

The Rubber Trade and Rubber Supplies.—The question whether the demand for rubber will continue to be met by the supply, or overtake and exceed it, is one of great importance to certain rapidly growing home industries. *The Times* recently expressed the opinion that the activity in planting in various parts of the earth makes the outlook less promising for the shareholders in new rubber companies, as the supply will overreach the demand, but the facts, so far as they are known, point to a somewhat different conclusion. The production of rubber steadily increases.

The world's consumption of rubber in 1903 was estimated at about 60,000 tons, last year it amounted to 65,000 tons, but it is worthy of note that the production of rubber in British colonies shows a large falling off. In 1896 it was 111,225 cwt., in 1904 it had fallen to 40,673 cwt., this decrease being due, no doubt, to the reckless way in which the wild rubber trees have been treated, as, for example, in Lagos, where in three or four years the rubber industry was practically destroyed by reckless tapping. There is no reason to suppose that in other parts of the world, outside the British dominions, where there is, and can be, no sufficient supervision, there has not been similar waste of the natural product. If this be so, it is not unreasonable to assume that the natural sources of rubber supply are being seriously affected, and must before very long disappear. The natural rubber trees and plants are scattered over such an enormous area that it is impossible to insure proper treatment of these trees, and in the absence of such treatment they cannot survive. It is said that there are vast untapped supplies of wild rubber in South America. It may be so, but it is certain that the supply from African sources is steadily decreasing, and whilst until now the imports of rubber from other centres, notably Brazil, Uruguay, and Peru, have more than compensated for the failure of the African exports, and collections from new ground may for a time more than make up for exhaustion elsewhere, year by year this new ground will be more difficult to find, and the conclusion seems unavoidable that before many years have passed the supply of natural rubber will diminish without the hope of recovery.

Plantation Rubber.—Under these circumstances there must be more and more dependence on plantations, and there is no good reason to suppose that in course of time they will not be fully equal to the world's demand. Dr. Schlieb, who speaks with authority on the subject, expresses a confident opinion that to yield permanently a ton of rubber per year requires not less than ten acres of plantation. That is a rather wide generalisation. Soil and climate have much to do with the yield of rubber, as with other products, and they vary widely. But even assuming that a thousand-acre rubber plantation can only be safely relied upon for a hundred tons of rubber, 650,000 acres would meet the whole of the present demand for rubber. Of course that would represent a very big area of plantation, and for many years to come natural rubber must form a large portion of the world's supply; but rubber planting is now being carried on on a very extensive scale, and ten years hence, when the natural supply may be visibly shrinking, the plantation supply will have very largely increased, and it has to be remembered that the loss from natural rubber is from 10 to 15 per cent. in manufacture, whereas that from the "biscuit" rubber, prepared from cultivated rubber, is generally less than 1 per cent. It would seem probable that for some years to come there will be no sensible diminution of the supply of natural rubber, there may even be some increase from the opening up of new areas, and the increase in the receipts of plantation rubber will, anyway, after the next year or two, meet, or nearly meet, the increased market demand, whilst ultimately it will bring prices down. For the cultivation of rubber is not like that of cotton attended with many difficulties, it is an easy and cheap cultivation, and the area of the earth's surface upon which it thrives is practically boundless. Nor must it be forgotten that there is always the possibility, some say the likelihood, of an efficient substitute for rubber being discovered.

The Cotton Industry.—The cotton trade continues active in all its branches, and notwithstanding the enhanced cost of machinery, &c., the building of spinning mills does not slacken. During the first ten weeks of the present year six new concerns were registered with a capital of nearly half a million, representing 500,000 spindles, and this activity may be expected to continue whilst trade remains anything like as good as it is at present. How good it is may be gathered from the following figures :—The total weight of yarn exported in the first ten weeks of the present year amounted to 36,000,000 lbs. as compared with 30,600,000 lbs. for the corresponding period of last year, and 28,872,000 lbs. in the same period of 1904. This increase in exports is mostly due to larger orders from India, Japan, and Roumania, and there is a distinct improvement in the home market. The export of piece goods for the first two months of the year amounted to 1,065,325,100 yards, as compared with 990,944,300 yards in 1905, and 939,621,100 yards in 1904; India taking as much as 40 per cent. of the aggregate exports of calico; whilst exports to the United States show a 50 per cent. increase on last years figures. It may be hoped that wages disputes will not interfere with the present prosperity. The operatives are working at a scheme to regulate wages according to the state of trade, which is of course the ideal arrangement, if only practicable.

Copper Output, Consumption, and Price.—The production of copper in the principal copper-producing centres of the world in 1905 was, almost without exception, larger than in 1904. The small output of Great Britain—500 tons—remained unaltered, and there was a slight decrease in the output of Italy—3,250 tons as against 3,335 tons—and in Russia—10,000 tons as against 10,700—but with these exceptions, and a falling off of a few tons in Germany—21,000 tons as against 21,045 in 1904—there were general increases, in some cases very substantial. The greatest increase was in the United States, where the output increased from 362,739 tons in 1904 to 421,000 tons in 1905; the next largest increase being that of Mexico—from 60,945 tons to 65,000. The total output was 723,550 tons, the largest known.

The following figures show how largely the production of copper has increased in recent years:—

1896.	1900.	1904.	1905.
Tons.	Tons.	Tons.	Tons.
373,360 ..	485,854 ..	648,924 ..	723,550

In ten years the production has nearly doubled, and the increase last year was no less than 74,626 tons. And yet although nearly 75,000 tons of copper were added to the world's output in 1905, standard copper rose nearly £11 per ton, from £68 8s. 6d. in January to £79 in December, partly through speculation, and partly owing to industrial demand. The increase in the consumption of the United States amounted to about 82,000 tons, or some 7,000 in excess of the total increased output of the year; but the consumption of Europe, as shown by the statistics, was much smaller—nearly 45,000 tons in Great Britain, Germany, and France—and allowing that requirements were met to a large extent out of stocks, not in public stores but those held by smelters, dealers, and consumers themselves it would seem that there was only a very small increase, if any, in European consumption during the year. Much of the increased amount of copper produced—some 60,000 tons—went to China to satisfy the currency demand, and this explains the apparent scarcity of copper in 1905, and was the chief cause of advances in price. The coinage scheme of China last year took 60,000 tons out of the industrial world, of which about 42,000 tons were shipped from the United States, so that China took all but about 15,000 tons of the increased supply, the balance being absorbed by the increased consumption of America. It is not unlikely that the output of 1906 will exceed that of 1905. New lodes have been discovered in America, and the output will probably show increase in Australia, Japan, and Mexico, whilst China will not make the same large demand on the world's supplies this year. On the other hand the present industrial activity, more especially in shipbuilding, makes larger consumption likely, and the consumption of copper in a big liner is probably larger than in any other class of work. The probabilities point to the price of copper being maintained at a high level throughout the year.

The Agricultural Returns for 1905.—The Agricultural Returns for 1905 have now been published—a preliminary statement appeared on the 24th November last—and show that seven of the eleven crops separately distinguished, proved above the average—wheat, beans, mangold, and hops largely so, while in none of the other four crops—oats, peas, and the two classes of hay—was the deficiency a very large one. The wheat crop was an exceptionally good one, the total production amounting to 58,902,499 bushels, or over 22,000,000 bushels more than in 1904, and larger than in any previous year since 1899. The average yield of hops exceeded 14 cwt. per acre, and was the largest on record, almost $1\frac{1}{2}$ cwts. above the high estimate of 1899, and 64 per cent. over a ten years average. The total production of hops has only once been surpassed, namely in 1886, when no less than 70,000 acres were under the crop. The yield of 1905 exceeded by 140 per cent. that of the preceding year. The least satisfactory crop of the year was the hay crop, both categories being below the average.

OBITUARY.

Charles Critchett.—Mr. Charles Critchett died at his house, 35, Albion-street, Hyde-park, W., on the 8th inst. He was the son of Richard Critchett, a noted sportsman of his day, and was born on the 3rd of October, 1826. He was a younger brother of George Critchett, the well-known ophthalmic surgeon, who died in 1882. Sir Anderson Critchett, who succeeded to his father's reputation as an oculist, is his nephew. He was originally intended for an engineer and studied for some little time under Mr. Locke, but he abandoned the idea and entered at Trinity College, Cambridge, where he took his degree in 1855. He was the contemporary at Trinity of the present Archbishop of York, the Master of Trinity, and of Viscount Selby, the late Speaker.

Very soon after leaving Cambridge, in 1856, he became Assistant-Secretary of the Society under the late Mr. Le Neve Foster, who was then Secretary. It was at a time when much store was set on the principle of competitive examination, and the Council of the time determined to make the appointment dependent upon competition. Charles Critchett was easily first amongst the candidates. He held the appointment until 1869 when he resigned it at his own wish, but his association with the Society was continued for another ten years, during which time he superintended the examinations as educational officer. In this capacity he had charge of the technological examinations which were founded in 1873, and were continued under the Society of Arts until their transfer to the newly established City and Guilds of London Institute in 1879. During his tenure of the office Mr. Critchett contributed an annual report on the progress of the examinations to the columns of the *Journal*. On his retirement the Council, in consideration of the services he had rendered, elected him a Life Member under the provision of the bye-law empowering them to elect annually three such members. He was a man of very varied accomplishments and popular in society, of which he was very fond. He was a great lover of art and of music, and was a connoisseur in Persian china, of which he had an exceptionally good collection. Mr. Critchett was twice married, first to Miss Mary Burnaby, and secondly to Miss Eleanor Whalley, who survives him. He leaves no children.

JOHN JEWELL VEZEY.—Mr. Vezey, a member of the Society of Arts since 1890, died last week after a short illness. He was much interested in the work of the Society, and a constant attendant at the evening meetings; also on several occasions he acted as scrutineer at the annual meetings. Mr. Vezey was born on the 25th November, 1844, he was educated privately, and for forty years engaged in business as a wharfinger in Mincing-lane. He was an active Fellow of the Royal Photographic and the Royal Microscopical Societies, of which latter society he was treasurer at the time of his death. He was also treasurer of the Quekett Microscopical Club and the Röntgen Society, and a member of the Board of Visitors of the Royal Institution. He was active in church and philanthropic work, and sat on the governing bodies of several hospitals and educational institutions.

GENERAL NOTES.

SAXON SNELL PRIZE.—The Henry Saxon Snell Prize was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is to be awarded by the Council of the Royal Sanitary Institute at intervals of three years, the funds being provided by the legacy left by the late Henry Saxon Snell, F.R.I.B.A. The prize will consist of £50 and a medal of the Institute, and is offered in the year 1906 for an Essay on "Suggestions for Improvements in Sanitary Appliances, for use in workmen's dwellings and labourers' cottages under the varying conditions of water supply and drainage usually obtaining in towns and villages." Essays must be delivered before 4 p.m., on or before September 30th, 1906, addressed to The Secretary of the Royal Sanitary Institute, 72, Margaret-street, W. Further information can be obtained of the Secretary of the Institute.

DEVELOPMENT OF MESOPOTAMIA.—A correspondent, writing to the German *Tageblatt* from Bagdad, states that in that part of the Ottoman Empire still known as Mesopotamia, many improvements are being made which can be distinctly described as modern. The Vilayet Mossul, on the middle Tigris, is extremely rich in all agricultural products, and during the past ten years much has been done to introduce rational methods of farming. The Bedouins are becoming less nomadic in their habits and are leaving the neighbouring steppes to become permanently domiciled upon the land which is being irrigated and reclaimed from the state of waste which has characterised it for centuries. The projected Bagdad Railway, a German enterprise, will pass directly through this country and bring it within easy reach of the commercial world. Two new steamers built in England are now plying on the Tigris. They are owned by a native company and are fitted up with all modern appliances, such as electric light, &c. A reconstruction of the ancient dams of Hillah is also being planned. All that is necessary to make this country one of the most prosperous in the East is the advent of the railway above mentioned.

ACCIDENTS IN AMERICAN COAL MINES.—It is a somewhat remarkable fact that in 1904—the latest year for which the returns are available—the percentage of fatal accidents per 1,000 persons, in and about the mines of the United States, was higher than in any year since 1895. Commenting upon the increase in the anthracite district, Mr. Roderick, Chief of the Pennsylvania Department of Mines, says that these accidents occur with "alarming frequency," and this is especially true of the accidents that result from falls of coal, slate, and roof, and from mine cars. At least one half of these accidents could have been avoided, if the victims themselves, their *co-employés*, and the men directly in charge of the mines had been more careful. On an average, six lives are lost by "falls" to one by explosion of gas. While the law requires that as the men advance in their workings the persons in charge shall see that all dangerous parts are taken down this is only partly done. Every year when the accidents that occur in and about the coal mines are analysed it is found that the responsibility rests, to a great extent with the victims themselves. Of the 595 lives lost in 1904 in and about the anthracite mines, 282, or 47·39 per cent., were lost through the negligence of the victims; 56, or 9·4 per cent. through the negligence of other persons. In the case of 53, or 8·91 per cent. of the accidents, the responsibility could not be determined, and the remaining 204, or 34·29 per cent., are classed as unavoidable. These figures, says Mr. Roderick, are "truly a sad commentary on the supervision and carelessness of the persons most interested—the operators, superintendents, foremen, and miners."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 28.—"Coal Conservation, Power Transmission and Smoke Prevention." By ARTHUR J. MARTIN, M.Inst.C.E. THE HON. RICHARD C. PARSONS, M.A., Member of Council, will preside.

APRIL 4.—"Ramie and its Possibilities." By MRS. ERNEST HART. Illustrated by Samples manufactured by A. M. Hart, Ltd.

APRIL 25.—"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT.

MAY 2.—"Submarine Signalling." By J. B. MILLET.

MAY 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By PROFESSOR THOMAS OLIVER, M.D., LL.D.

MAY 16.—"The Development of Watermarking in Hand-made and Machine-made Papers." By CLAYTON BEADLE.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

APRIL 26.—COLONEL SIR ARTHUR HENRY McMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

MAY 8.—"Damascening and the Inlaying and Ornamenting of Metallic Surfaces." By SHERARD COWPER-COLES.

MAY 29.—"Glass Cutting." By HARRY POWELL.

*** This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

Mr. Thomas Okey's paper on "Basket-making" has been unavoidably postponed until next session, and the above dates of meetings have been altered from April 24th and May 15th previously announced.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

LECTURE III.—MARCH 26.—Storage Dangers—Spontaneous Ignition of Material in Bulk—Lampblack—Charcoal—Coal—Fibre—Greasy Waste and Rags—Vapours—Dust and Dust Explosions—Nitro Compounds—Collodion Goods.

LECTURE IV.—APRIL 2.—Fire Prevention—The Fallacies Existing as to Fireproof Material—Stone and Iron *versus* Wood—Heat Conductivity—Fireproofing Wood and Textile Fabrics—Fire Extinction—Sprinklers—Chemical Fire Extincteurs—Alarms.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Vivian B. Lewes, "Fire, Fire Risks, and Fire Extinction." (Lecture III.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. William Woodward's paper, "The Means of Locomotion and Transport in London."

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m.

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. S. M. Mitra, "The Partition of Bengal and the Bengali Language."

Medical, 11, Chandos-street, W., 8½ p.m.

Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. H. Beaumont, "A Tour in Central France, including the Cathedrals of Bourges and Tours."

TUESDAY, MARCH 27...Tramways and Light Railways Association (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Mr. Norman D. Macdonald, "Motor-car Services in Relation to Tramways."

Royal Institution, Albemarle-street, W., 5 p.m. (Tyndall Lecture.) Dr. J. E. Marr, "The Influence of Geology on Scenery." (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 1. Discussion on Mr. H. Shelford Bidwell's paper, "The Outer Barrier, Hodbarrow Iron Mines." 2. Mr. Cathcart W. Methven, "The Harbours of South Africa."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. T. Thorne Baker, "The Application of Spectro-Photography to Technical Chemistry."

WEDNESDAY, MARCH 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Arthur J. Martin, "Coal Conservation, Power Transmission, and Smoke Prevention."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, MARCH 29...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. B. Hopkinson, "Internal Combustion Engines." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. C. B. Sparks, "Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Company." 2. Mr. W. C. Mountain, "Electric Winding, considered Practically and Commercially."

United Service Institution, Whitehall, S.W., 3 p.m. Rev. F. H. Traly, "Public School Education and the Training of Candidates for the Imperial Services."

FRIDAY, MARCH 30...Royal Institution, Albermarle-street, W., 9 p.m. Prof. P. Zeeman, "Recent Progress in Magneto-Optics."

International Congress on School Hygiene, in the Jehanghir-hall of the University of London, South Kensington, S.W., 5 p.m.

Chemical, Burlington-house, W., 5 p.m. Annual Meeting.

SATURDAY, MARCH 31...Royal Institution, Albermarle-street W., 5 p.m. Prof. J. J. Thomson, "The Corpuscular Theory of Matter." (Lecture V.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, APRIL 2, 8 p.m. (Cantor Lecture.) PROFESSOR VIVIAN B. LEWES, "Fire, Fire Risks, and Fire Extinction." (Lecture IV.)

WEDNESDAY, APRIL 4, 8 p.m. (Ordinary Meeting.) MRS. ERNEST HART, "Ramie, and its Possibilities."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 26th inst., PROF. VIVIAN B. LEWES, delivered the third lecture of his course on "Fire, Fire Risks, and Fire Extinction."

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

SEVENTEENTH ORDINARY MEETING.

Wednesday, March 28, 1906; THE HON. RICHARD C. PARSONS, M.A., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Barclay, S. F., The Elms, Queen's-park, Manchester.
Forsyth-Martin, Alexander, Chief Surveyor, Royal Railway Department, Siam.
Marriott, Hugh Frederick, care of Messrs. Wernher, Beit and Co., 1, London-wall-buildings, E.C.
Maynard, Henry W., St. Aubyns, Grosvenor-hill, Wimbledon.
Mookerjee, R. N., Messrs. Martin and Co., 6 and 7, Clive-street, Calcutta, India.
Pal, J. N., I.C.S., Joint Magistrate, Sitapur, United Provinces, India.
Rand, William George, 82, Hurstbourne-road, Forest-hill, S.E., and The Niger Company, Ltd., Surrey-house, Victoria-embankment, W.C.
Sullen, Arthur E. B., Dunmurry-house, Simla, India.
Venkayya, Rai Bahadur Valaiyattur, Officiating Government Epigraphist, Ootacamund, India.

The following candidates were balloted for and duly elected members of the Society:—

Barriga, Manuel Diaz, 75-80, Dashwood-house, New Broad-street, E.C.
Champion, Henry Vane, M.Inst.C.E., Equity Trustees-building, 87, Queen-street, Melbourne, Australia.
Cooksley, Alfred, 12, Woodview-gardens, Highgate, N.
Hamilton, Captain James de Courcy, R.N., Head-quarters, Fire Brigade, Southwark, S.E.
Kawai, I., Bureau of Camphor Monopolization, Kumoidori, Kobe, Japan.
Kirby, Thomas E., American Art Association, Madison-square South, New York, U.S.A.
Pickering, John William, 76, Clarendon-road, Walthamstow, Essex.

The paper read was—

COAL CONSERVATION, POWER TRANSMISSION, AND SMOKE PREVENTION.

By ARTHUR J. MARTIN, M.INST.C.E.

THE PROBABLE DURATION OF OUR COAL SUPPLIES.

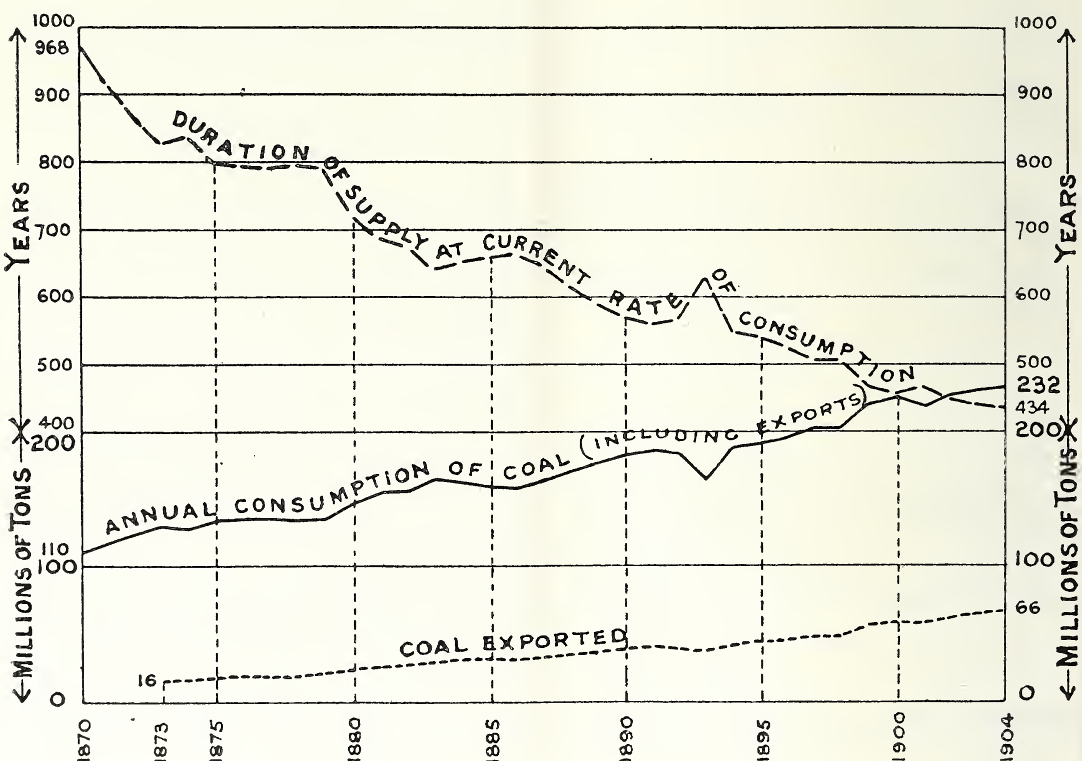
The supreme importance of husbanding our coal resources will, I think, be conceded by all. Not only is coal the chief source of the artificial light and heat which have become so essential to our comfort, if not to our life itself, but it is at once the mainspring of the gigantic system of manufactures by which we earn our daily bread, and of the mighty fleet which

enables us to hold our place among the nations.

Our coal supplies may, without exaggeration, be described as the foundation of our national greatness. May we not further say that our very existence as a nation depends on them? How then are we dealing with this priceless national asset, and how long may we expect it to last?

These questions formed the subject of a prolonged and exhaustive investigation by the Royal Commission on Coal Supplies, which was appointed towards the close of 1901, and issued its final report in January of last year. As the result of an extensive series of calculations, made by witnesses intimately acquainted with the various districts, the Commissioners estimated the available quantity of coal in the "proved coalfields" of the United Kingdom at 100,914,668,167 tons.* The consumption, which was about 2,000,000 tons per annum in 1660, and had risen by 1870 to 110,000,000 tons, shows a further steady increase to 1904, when it reached a total of 232,000,000 tons.† The consumption for each year from 1870 to 1904 inclusive is shown by the firm line on Fig. 1. The broken line above the firm line shows how long the supply available at the end of each year would last at that year's rate of consumption. Thus, at the rate which prevailed in 1870, the then supply would have held out for 968 years; the 1885 consumption would have exhausted it in 657 years, while at the end of 1904 there only remained 434 years' supply at the 1904 rate of output. These figures show only how long the supply would have lasted had the rate of consumption remained unchanged; they take no account of the all-important influence of the increase in consumption from year to year. The rate of increase for the 34 years under review averages 2·2 per cent. per annum, equivalent to the doubling of the output every 32 years. If the consumption should continue to increase at the same rate, a simple calculation shows that the supply in the proved coalfields would last just over a century—to be exact, to the autumn of 2012. The "concealed and unproved coalfields" are estimated to contain a

Fig. 1.



Coal Consumption and Duration of Supply.

* "Mines and Quarries: General Report for 1904," p. 193.
† Final Report, p. 2.

further supply of 39,483 millions of tons, which, at the same rate of increase in consumption, would last another 14 years, or 122 years in all; but referring to the supply in these unproved coalfields, the Commissioners significantly remark that they have "thought best to regard it . . . only as probable or speculative."*

These estimates of our coal resources take account only of the coal within 4,000 feet of the surface, which the Commissioners have adopted as "the limit of practicable depth in working" (p. 2). The extension of mining operations below that depth would not, however, add very materially to the supply, the quantity of coal at a greater depth than 4,000 feet being estimated at under 5,200,000,000 tons, or 18 months' supply at the rate of consumption anticipated in 2026.

The Export of Coal.

Below the firm line on the diagram showing the annual output of coal there is a dotted line, which represents the quantity exported in each year. As a matter of fact it includes, not only the coal shipped to foreign countries, but also that (about one-fourth of the whole) supplied to the British and Foreign steamers engaged in foreign trade.

The exports for 1873, the first year for which complete records are given, amounted to 16,000,000 tons. By 1904 they had risen to close on 66,000,000 tons. In 1873 we exported barely $12\frac{1}{2}$ per cent. of the total output; in 1904 no less than 28 per cent. went abroad. The increase in foreign shipments in the 31 years covered by the returns is thus over 300 per cent. The increase in home consumption during the same period was only 48 per cent.

Leaving percentages, and coming to absolute totals, the increase in the coal exported since 1881 exceeded by some three million tons the increase in the whole of the home consumption. It is significant that the increase in exports continues in the face of an export duty on coal which was characterised by a recent deputation to the Chancellor of the Exchequer as "a cruel burden upon the miner," and which it is now proposed to repeal.

In putting forward the foregoing figures I do not suggest that our stock of coal will come to an end in 108 or 122 years, as the case may be, these periods being merely those required to exhaust our resources if the present rate of increase in the consumption is maintained. That they will not be exhausted within any such period is obvious, since the pressure of the demand upon the supply, and the exhaustion of the beds which are most easily worked will bring about a rise in price which will act as a powerful brake upon consumption. How long, taking all the circumstances into consideration, the supply is likely to hold out, the Commissioners do not venture to estimate. They give, however, in an appendix to their final report, some elaborate Tables and diagrams prepared by Mr. Price-Williams, according to which the "proved coalfields" will be exhausted in about 211 years. Even this guarded estimate should not be taken too literally, for the sudden exhaustion of our coal mines is, for the reason given above, a practical impossibility.

What is practically certain is that at no very distant date a cheap and abundant supply of coal, such as we enjoy to-day, will have become a thing of the past. Already our American competitors are noting with satisfaction "the rapidly diminishing supply of coal and other raw materials in Europe," and the consequent "decadence of manufactures in the older countries," and looking forward to the time when our staple industries will pass into their hands.*

Whether the impending coal famine sets in 20 years hence or 200, it is not a thing to which we can look forward with satisfaction; and the historian of the year 2100 is not likely to form a favourable judgment of the ancestors to whose extravagance his own generation owes its deprivation of one of the prime necessaries of life.

Looking at the matter from its ethical side, it may well be questioned what right we, as mere tenants for life and trustees for the generations to come, have to squander their share, as well as our own, of an inheritance which has taken untold ages to accumulate, and which, once lost, can never be replaced. If any question of the kind is raised, it is apt to be met by glib talk of some new discovery, such as the utilisation of radium, or of the solar rays, whereby we shall be enabled to dispense with coal.

The Commissioners devote some space to a consideration of the possibility of finding an alternative source of energy, and come to the following conclusion, "we are convinced that coal is our only reliable source of power and that there is no real substitute. There are,

* Final Report, p. 6.

* Report of Secretary and Superintendent Pittsburg Chamber of Commerce, 1900.

however, some possible sources of power which may slightly relieve the demand for coal."*

Our National Food Supply.

It is not merely for power, light and heat that we have to look to our coal mines, for they have also a most important bearing on our national food supply. For the greater part of a century the wheat grown in this country has been utterly inadequate to our needs, which we have had, therefore, to supply from abroad. The proportion of imported to home-grown wheat has steadily increased, until at the present time the importations amount to something like two-thirds of the whole. The countries from which we draw our supply of wheat are rapidly filling up, and will before long, possibly within the next thirty years, require the greater part if not the whole of their products for their own people. Then, as Sir William Crookes pointed out in his Presidential address to the British Association in 1898, a wheat famine will set in, unless the productiveness of the soil can be increased by the use of chemical fertilisers. The nitrogenous manure which is most generally used just now is nitrate of soda, of which large quantities are imported from Chili. It is estimated that the supply of this substance, at the present rate of consumption, will be exhausted in less than fifty years. Then, as Professor Crookes informs us, our only chance of averting starvation lies through the laboratory. There is an alternative manure for wheat land, namely sulphate of ammonia, which is one of the chief by-products in the manufacture of gas from coal, and contains nearly 30 per cent. more nitrogen than is present in nitrate of soda. The strange part of the whole business is that, while we spend something like £15,000,000 per annum in getting nitrate of soda from Chili, we waste at least an equivalent amount of nitrogen by our primitive methods of using coal. The depletion of our coal mines not only brings us daily nearer to a coal famine, but is at the same time steadily breaking down our last barrier against starvation.

The Coal-Tar Industry.

There is yet one other direction in which the squandering of our coal resources involves a heavy loss to the country, namely, in connection with what are known as coal-tar products. Probably none of the many triumphs of chemical science surpasses in interest or importance the discovery that ordinary coal is a veritable storehouse of valuable by-products. Arrangements are now being made to celebrate the jubilee of the discovery by Dr. William Henry Perkin of mauve, the first of the aniline dyes, a discovery which laid the foundation of a new and important industry. It is humiliating to recall that the trade thus founded on the discovery of a British chemist has to a great extent slipped away from us into German hands. It was estimated in 1901 that the total annual value of Germany's coal-tar industry was between nine and ten million pounds sterling, and that the English export trade in coal-tar dyes, formerly one-quarter that of Germany, was then less than one-tenth*. Our generosity did not end with presenting the Germans with this new and valuable industry and in training their chemists to inaugurate it, for we send them year by year a great part of their raw material, and buy back our own coal-tar in its manufactured form.

The Wastefulness of Present Modes of Consumption.

So far I have dealt with the consumption of coal in the gross, without considering the purposes for which it is used or the modes of its application. I now propose to look at these in detail. It has been estimated by Mr. G. T. Beilby, past President of the Society of Chemical Industry, that about one-half of the coal consumed in this country is used for power production, three-tenths to produce heat for industrial purposes, and one-fifth to produce heat for domestic purposes.

Losses in Power Production.

By far the largest part of the power used in this country is generated by means of boilers and steam engines. A pound of ordinary coal yields about 14,000 British thermal units, and, if the whole of this could be converted into mechanical energy, it would represent about $5\frac{1}{2}$ horse-power hours. It is, however, impossible in the present state of our knowledge to convert anything like the whole of the heat energy of coal into mechanical work, the proportion so converted by a boiler and engine of the most economical type being about 14 per cent. What becomes of the rest of the heat will be seen from Fig. 2. On this diagram, the heat which is converted into mechanical energy is indicated by the black

* Final Report, p. 17.

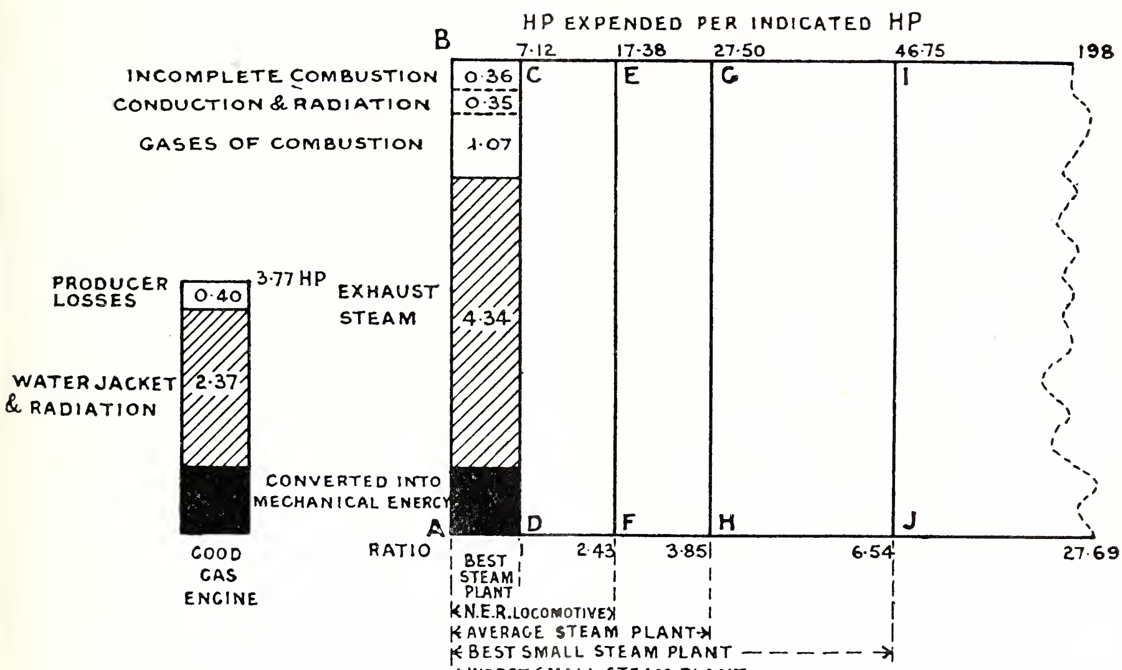
* B. A. Reports, 1901, p. 252.

square. The hatched part of the column represents the loss in the engine, and the white portion the boiler losses.

Taking the latter first, some 5 per cent. of the heat is lost by imperfect combustion, or retained in the ashes; another 5 per cent. escapes by conduction and radiation, and 15 per cent. passes off in the chimney gases, the balance, amounting to 75 per cent., being usefully expended in generating steam. The engine cannot utilise more than one-fifth of the heat imparted to the steam, and the balance is carried off by the exhaust.

of the mechanical energy obtained from the steam is expended in overcoming the internal friction of the engine. This loss in a large engine in good order may not exceed 10 per cent. of the whole, but in a small engine it may reach one half. Again the power of the engine is usually transmitted to the machinery by means of a train of belting and shafting, which also absorb their quota; and if, as often happens, only a part of the machinery driven by the engine is in use at one time, the proportion of the power actually utilised may be reduced to a very low figure. Often, indeed, the boiler has to be kept under steam for hours while no power at all is being used. Taking all these losses into consideration, it is probable that there are large numbers of steam plants at work throughout the country which consume a hundredweight of coal for every pound which would suffice to do the work with a boiler and engine of the most economical type working under the most favourable conditions.

Fig. 2.



Losses in Power Production.

This result, poor as it is, is the best that can be obtained in a steam plant of the most economical type, consuming about 1·3 pounds of coal per indicated horse-power per hour. Five express locomotives, belonging to the North Eastern Railway, showed an average of 3·16 pounds. The average consumption of steam-engines and boilers in Great Britain was estimated by Mr. Beilby at five pounds, while actual tests of a number of small steam plants in Birmingham showed a coal consumption of 8·5 pounds per hour in the case of the best engine, and 36 pounds in that of the worst. The losses do not end here. A part

Of late years gas-engines have come into very general use, especially where the power required is small. A gas-engine and suction gas plant recently tested by Messrs. Crompton

and Co. consumed 0·78 pounds of coke per indicated horse-power, the losses being as follows :—

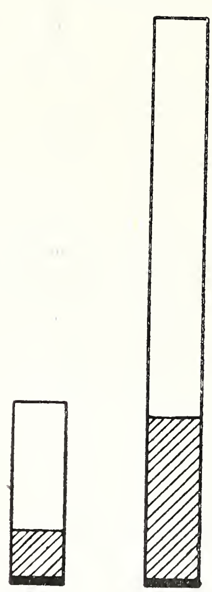
	Per cent.		Horse-power per hour.
Loss in gas producer....	10·50	..	0·40
Engine losses by water jacket, radiation, &c...	62·96	..	2·37
Converted into mechanical work................	26·54	..	1·00
	100.00		3·77

From these results, which are also shown in Fig. 2, it will be seen that the gas-engine in question was considerably more efficient than the most efficient steam-engine.

Losses in Heat Production.

In the use of coal for heating purposes similar losses occur, these being to a certain extent unavoidable, but largely due to imperfect modes of combustion. Where coal is used for household purposes the losses are very high. Their amount varies very much with the type

Fig. 3.



Losses in Domestic Use.

of grate or stove, and the skill or otherwise with which it is tended ; but it is estimated that not more than one-eighth of the heat from the coal burnt in an ordinary grate goes to warm the room, and that the ordinary kitchener utilises only about 4 per cent. The efficiency of these two appliances is shown in Fig. 3, in which the black strip represents one penny, the black and hatched portions together the number of pennyworths of coal (at pit's-mouth prices) which are burnt to realise the amount of heat obtainable from one pennyworth, and the whole column the price actually paid for the coal, taking into account the cost of carriage and distribution. Thus, to utilise the amount of heat contained in a pennyworth of coal, the user has to pay 2s. 3d. or 7s. 0¾d., according as he requires it for heating or cooking purposes. In the latter case he pays the price of a ton of coal (at the pit's mouth), and obtains in return the heat units from a pennyworth. This is irrespective of the cost of labour in laying in fires, carrying coals and cleaning grates, which in most houses comes to far more than that of the coal itself. This point is of special importance in comparing the cost of coal and gas for household use.

Indirect Cost of Present Methods.

There remains to be taken into account the indirect cost of the ordinary methods of using coal. The results of these methods are set forth at length in several of the papers read at the Smoke Abatement Conference recently held in Westminster, and I do not propose to enlarge on them here. It will suffice to mention that a conservative estimate of the monetary loss entailed by smoky fogs places it at something like £5,000,000 per annum, while the Registrar-General's returns show a loss of life directly traceable to fogs of several thousands in a single winter.

Whether we look at the rapid exhaustion of our coal mines, or the consequences which present methods of burning coal bring in their train, it will hardly be contended that the prospect is a satisfactory one.

Possible Economies.

It is the fashion just now to talk a good deal about "efficiency." Nowhere is there greater scope for efficiency than in the use of coal, and much of the evidence given before the Royal Commission was directed to showing how such efficiency might be secured.

In power production it was shown that much could be done by the substitution of economical steam-engines for inefficient ones, or by replacing steam-engines with gas-engines. In the various processes in which coal is used for heating purposes large economies may be effected by turning the coal into gas, and by

passing the products of combustion through "regenerators," in which to intercept the escaping heat and transfer it to the air which feeds the fire. Other economies were described, applicable to the particular classes of work with which the witnesses were respectively concerned.

Mr. Beilby furnished an interesting Table, containing an analysis of the total consumption of coal in 1903, and indicating the saving which might be effected in each item.

The substance of this Table is reproduced in Fig. 4.

Taking Mr. Beilby's savings at the higher figure, which is certainly not an excessive one, and pricing the coal saved at an average of 12s. per ton, it works out at £36,000,000 per annum. During practically the same period our navy cost us £35,476,000, and our army £36,677,000, so that the saving above indicated would pay the entire cost to the country of either of these services. At the present moment strong pressure is being brought to bear on the Secretary of State for War to secure a reduction of the Army Estimates. Is it permissible to hope that a small fraction of the effort which is being so persistently applied in this direction may be devoted to cutting down our annual coal bill and husbanding our coal resources?

The coal economies suggested by Mr. Beilby, while requiring some capital expenditure for their attainment, will in most cases be so great as to repay this expenditure in a very few years. The chief obstacles to the more general adoption of the necessary improvements are due partly to lack of time on the part of the persons concerned to attend to the matter, but in still greater measure to that almost passionate dislike of innovation which is so characteristic of the English and of the Chinese.

The Question of Transport.

The savings above referred to are particular to the individual industries enumerated, being merely such as might be effected within the domain of each industry separately considered, and take no account of the grander economies which can be effected by dealing with our coal consumption as a whole. Moreover, they leave untouched the question of transport, which is of vital importance, both from a coal user's and from a national point of view. Our present primitive methods of obtaining our heat supply are so familiar to us that we do not give them a thought, but our grandchildren will look back with amazement on the long chain of operations which we are content to employ for the purpose. Let us follow the coal from its digging by hand in the mine, through its elevation to the pit's mouth, the screening and washing operations at the surface, the loading, hauling and shunting of the wagons, the bagging and weighing of the coal, its crawling progress through our crowded streets, its conveyance on men's backs to our cellars, and last but by no means least, its carriage up many flights of London stairs, to its final smoky exit through the chimney, and then let us reconsider our claim to be regarded as an intelligent and practical people. Looking at the price which we pay for coal, which, to the London householder is

Coal Consumption and Economy.*

	Consumption in millions of tons.	Saving in millions of tons.	Means of Economy.
Railways	12 to 14	5 to 7	Gas generators and engines, and electric motors and electric traction.
Steamers	6 ,, 8	,,	
Factories	40 ,, 45	20 ,, 30	
Mines	10 ,, 12	5 ,, 7	
Blast furnaces	16 ,, 18	2 ,, 3	Gas engines and recovery ovens.
Iron and steel	10 ,, 12	2 ,, 3	
Other metals	1 ,, 2	—	—
Brickworks, potteries, glassworks, chemical works	4 ,, 6	1 ,, 2	Gas generators and coke.
Gas works	14 ,, 15	—	Gas cooking and heating briquettes and coke.
Domestic fires	30 ,, 36	5 ,, 8	
	143 ,, 168	40 ,, 60	

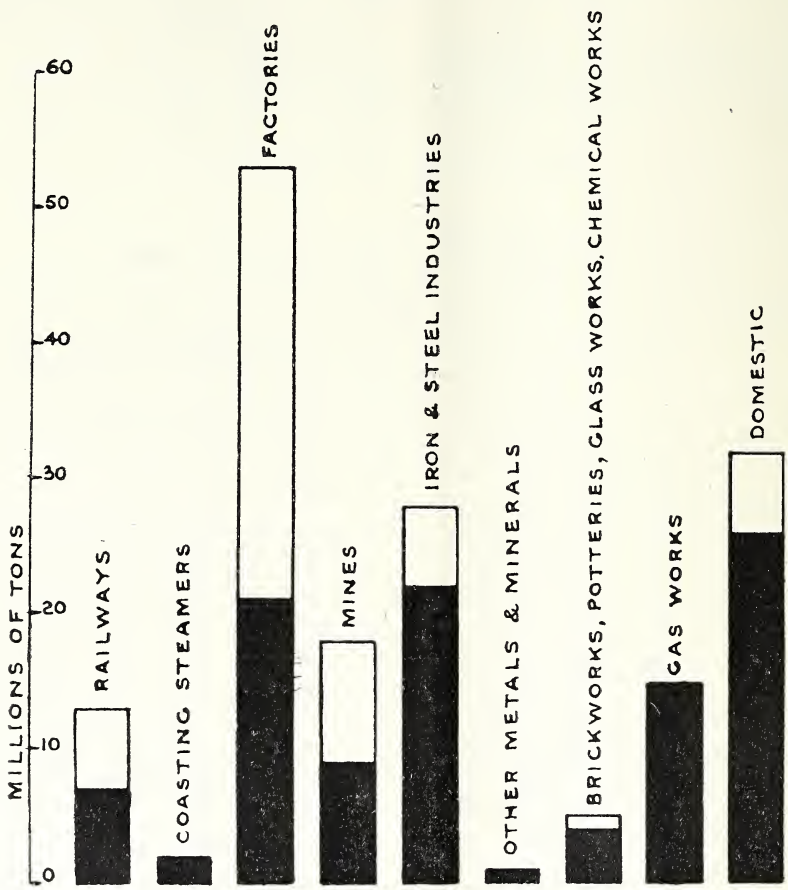
* R.C., 2nd Rep., vol. ii., ansr. 9,631.

rarely less than three times its cost at the pit's mouth, and remembering that this cost is practically doubled by the railway carriage alone, we are apt to think the railway charges unreasonable. A few witnesses before the Commission suggested this, but, having regard to the evidence of other witnesses, the Commissioners regarded the allegation as not proven, and held out no hope of any material reduction in the cost of transport.

THE ELECTRICAL TRANSMISSION OF POWER.

Proposals for the electrical transmission of power are by no means novel. The present session of Parliament will witness a keen competition for the supply to London of electricity, generated in huge stations by the waterside. Projects of this nature, while saving the *later* stages in the transport of coal, leave untouched the larger question of its conveyance from the collieries to the neighbourhood of the metropolis, and cannot, therefore, be regarded as a complete or final solution of the problem. This objection is overcome by the proposals which have been made from time to time for the generation of current at the pit's mouth, and its transmission at high tension to the metropolis and other centres of population. This was proposed so long ago as 1892 by Mr. Benjamin H. Thwaite, who later gave evidence before the Royal Commission. Mr. Thwaite, in bringing forward his original proposal, estimated that the

FIG. 4.



COAL CONSUMPTION AND ECONOMY.

The practical outcome of this part of their inquiry is contained in the 66th paragraph of their "Final Report":—

Transmission of Power instead of Coal.

"The evidence points to a future extension of central power stations, and the generation and transmission of power upon a large scale. If such stations were established in close proximity to the collieries, there would be nothing to pay on the coal in the way of railway rates, and the question would then be, not the cost of transport of coal, but the cost of transmission of power."

interest on the cost of the trunk lines would almost be covered by the saving of the expense now incurred in the cartage of coal, to say nothing of its carriage by rail.

The feasibility of the electric transmission of power has been conclusively proved by experience on a large scale in various countries in both the old and the new worlds, the distances covered ranging up to 222 miles, and in one instance (temporarily) to 270 miles. These examples, however, are not conclusive as regards the commercial practicability of transmitting power electrically from the coalfields. In the first place, the power transmitted has been derived from waterfalls, and not from coal; secondly, the working potentials were very high; and, thirdly, bare overhead conductors were used.

Within certain limits the cost of coal would not be a serious matter, for it is estimated that no less than 24,000,000 tons per annum, or more than twice as much as is consumed in the county of London, are brought to the surface and tipped to spoil, besides which large quantities of similar material are thrown away into disused workings underground. This small coal has a high calorific value, and would serve, so far as it went, for the generation of the power to be transmitted.

The cost of laying down and working the power plant, and the distrust with which bare overhead conductors and high potentials are regarded in this country would, however, seriously handicap any scheme of long distance electric transmission.

Transmission by Compressed Air.

In Paris for many years past compressed air has been used with great success for the distribution of power. In 1895 a New York engineer published calculations showing that air could be compressed by power obtained from refuse coal at the mines, conveyed in pipes 100 miles and used in motors at the cost of £3 8s. 0d. per horse-power per annum delivered.*

Transmission by Gas.

From power transmission by compressed air it is but a short step to the conveyance of gas under pressure for the same purpose. The mode of transmission is the same in both cases; but as regards the medium employed the advantages of gas over air are overwhelming. Working at a pressure of six atmospheres, as in Paris, a good motor requires some 550 cubic feet of air per indicated horse-power per hour; in a gas-engine $14\frac{1}{3}$ cubic feet of ordinary lighting-gas will do the same work. The specific gravity of lighting-gas being only four-tenths (taking air as unity), the volumes of the two fluids carried by the same main will be in the proportion of 16 to 10, if the initial and terminal pressures respectively are the same in both instances. This, however, would not be the case, for, whereas with air a small part only of the initial pressure is employed for transmission purposes, every pound of pressure consumed in this way being so much less available for working the motors, in dealing with gas the whole power of the compressors may be used to force the gas through the pipes, the power to be realised at the receiving end depending, not merely on the pressure of the gas as received, but chiefly on its calorific value. By reason of these various advantages, a main and compressor-plant dealing with gas will transmit no less than 150 times as much power as could be sent by means of air. Add to this the fact that the use of compressed air is practically limited to the production of power, whereas gas serves also as a source of light and heat, and it will be seen that the commercial possibilities of compressed air, great as they are, dwindle into insignificance beside those of gas.

Comparison of Electrical and Gas Transmission.

In comparison with electricity, also, gas comes out very favourably. As pointed out in my paper contributed to the recent Smoke Abatement Conference* the transmission of gas (working within reasonable limits of cost), is much more efficient than the transmission of electricity. It is, however, upon its great superiority in point of adaptability and convenience that the case in favour of gas mainly rests. For lighting purposes, as well as for power production, the two run a close race. For heating, except in certain special applications, gas has it all its own way, chiefly by reason of the enormous losses (amounting to close on 90 per cent.) which have to be incurred in obtaining electrical energy from coal.

The weakest point of electrical transmission, however, is the absence of any means of storing electrical energy on a large scale at anything like a reasonable cost. Owing to this the whole of the generating, converting and transmitting plant must be capable of supplying

* *Engineering Magazine*, July, 1895, p. 770.

* "How to Prevent Smoky Fogs," (Sanitary Publishing Co.), p. 22.

current at the greatest rate at which it is liable to be called for at any moment, and an ample reserve of capacity must be provided in case of the breakdown of any part of the system. Gas, on the other hand, can readily and cheaply be stored in any desired quantity, for as long as may be desired, and used at any moment and in any quantity without deterioration or loss. It would only be necessary, therefore, to lay down manufacturing, compressing, and transmitting plant on the scale required to satisfy the *average* demand, and the whole of it might if necessary be shut down for a time without interrupting the supply.

Obstacles to Gas Transmission.

Seeing that gas transmission possesses so many solid advantages, the question naturally suggests itself why it is not more generally used. The reason is that down to very recently it has not been considered possible to convey gas with any success over long distances. Sir William Siemens is said to have suggested it many years ago. Professor Unwin, in his Howard Lectures on "The Development and Transmission of Power from Central Stations," delivered before the Society of Arts in 1893, pointed out the advantages of gas distribution over distribution by compressed air or electricity. At least three of the witnesses before the Royal Commission on Coal Supplies proposed the use of gas for transmission purposes, one of them, Professor Burstall, going so far as to suggest that the producing plant should be located at the pit's mouth.* Other authorities, however, whose opinion it was impossible to ignore, have characterised the proposal to pipe gas from the coalfields to the metropolis as impracticable.

There are many reasons why it should have been so regarded. To begin with, coal-gas was first brought into use simply as an illuminant, and down to very recently this has been its most important function. Its value for illuminating purposes has depended on the presence of certain hydro-carbons, and experience had seemed to show that the proportion of these was reduced when the gas was subjected to pressure. The lack of efficient compressors and of pipes and joints capable of withstanding, without excessive leakage, the pressures which would have had to be employed, also constituted very serious obstacles to the long-distance transmission of gas.

* R. C. 2nd Rep., vol. ii., 10,503.

Dealing with these difficulties in order, and taking first the question of loss of illuminating power, further experience has shown that gas can be subjected to considerable pressures without suffering any serious falling off in this respect. The illuminating value of gas moreover is not now as a rule dependent on its own luminosity, but is obtained by the use of refractory earths in the form of mantles.

Great strides have lately been made in the design and manufacture of air compressors, one of those used in the Paris compressing station having a total efficiency as high as 77 per cent. Steel pipes capable of carrying high pressures are now on the market, and modes of jointing have greatly improved. Not only so, but pipes are obtainable in 28 feet lengths, as against 9 feet 30 years ago, so that one sound joint now takes the place of three indifferent ones.

Instances of Gas Transmission.

As the result of these improvements the dream of the man of science has now become an ordinary engineering achievement. In the United States 4,000,000 people are supplied with light and fuel (for all purposes) by natural gas, conveyed under pressures up to 300 lbs. per square inch to distances ranging up to 200 miles. High pressures are used also in connection with manufactured gas, the gasholder in one instance being supplied under pressure from a manufacturing plant no less than 35 miles away. The Western United Gas and Electric Company of Illinois supply 24 cities and towns, with a combined population of 140,000, and an extreme distance between centres of 52 miles. At present there are four main gas works and one small one connected with the one pipe system; but the small plant will soon be shut down, and arrangements are on foot for supplying the whole territory from a single generating station. Mr. H. L. Rice, the manager of this company, states that already a plant is being developed to transport manufactured gas 200 miles to a large American city. While we cannot in this country point to any such striking instances of long distance transmission, Nuneaton has a system of high-pressure mains supplied at a pressure of nine pounds from a holder receiving gas at 40 pounds pressure. The question, therefore, is no longer whether gas can be conveyed at high pressures, but simply whether it will pay to do so in any particular case.

Mond Gas and Water Gas.

A notable undertaking in the industrial field is that of the South Staffordshire Mond Gas (Power and Heating) Company, whose territory, 163 square miles in area, stretches from Birmingham to Wolverhampton. Instead of coal-gas of the ordinary type, they supply a variety of producer gas, the process employed being specially designed with a view to the recovery of ammonia. As showing its efficiency in this respect, it was stated by Professor Burstall, in his evidence, that "the value of the ammonium sulphate recovered per ton of slack is about 4s. 6d., which represents about three-quarters of the cost price of the slack if the situation of generation is favourable."* This large return from a by-product enables the company to sell their gas at a very low figure, the price charged ranging from 4d. per thousand cubic feet down to 2d. for large quantities. On the other hand, the calorific value of the gas is only about one-quarter of that of coal-gas. The gas which Professor Burstall proposed to generate at the pit's mouth for long-distance transmission was of this type. Besides this and other varieties of fuel-gas, we have what is known as "water-gas," which occupies an intermediate position between producer-gas and coal-gas proper. Any of these is admirably adapted for heating purposes, but for long-distance transmission they do not compare favourably with coal-gas. This is chiefly due to their lower calorific value, necessitating the use of a much greater quantity to get a given amount of heat. By reason, moreover, of their greater density, more power must be expended to force an equal volume of any of them along the mains. These characteristics of the different gases and their influence on the cost of transmission are shown in the following Table.

For the purpose of this Table I have taken the net manufacturing cost of coal-gas at 4·89d., being that of the gas made by the Widnes Corporation in 1904-5, for information as to which I am indebted to Mr. Isaac Carr, gas engineer and manager; that of water-gas at 3d. as given by Mr. Karl Dellwik in his evidence;† while, in default of definite information as to the cost of manufacturing Mond gas, I have taken it at 1d. per 1,000 feet. It will be seen that Mond gas, in spite of this initial advantage in cost, is in the end the most expensive of the three, coal-gas being decidedly the cheapest.

* R.C. 2nd Rep. vol. ii., 10,405-6.

† R.C. 2nd Rep., vol. ii. 12988.

Most of these data are shown graphically on Fig. 5, in which the breadth of each column indicates the volume of gas required for a given duty, and its height the cost of that volume. The black part of the column shows the cost of manufacture, the hatched portion that of compression, and the white portion that of transmission. In view of the results shown in the Table and diagram I had no difficulty in selecting coal-gas as the most promising for transmission.

	Coal Gas.	Water Gas.	Mond Gas.
Cubic feet per pound ..	33·7	26	16
Heat units per cubic foot	617	328	144
Quantity equivalent to 1,000 c.f. of coal-gas..	1,000	1,884	4,285
*Cost of manufacture per 1,000 c.f.	4·89d.	3d.	1d.
	d.	d.	d.
Cost of making equivalent quantity	5·89	5·65	4·28
Cost of compressing ditto	0·39	0·74	1·68
Cost of transmitting ditto	0·44	0·95	2 76
Net cost of equivalent quantity delivered....	5·72d.	7·34d.	8·72d.

The Cost of Coal Gas.

Before going further, it will be well to consider how the cost of the gas supplied to London is made up. The price paid per thousand cubic feet ranges from 2s. to 3s., the latter being the rate charged by the Gas, Light, and Coke Company, who supply by far the largest part of the gas used in the metropolis. The following statement, which is taken from my former paper, already referred to,† was drawn up from the company's report for the half-year ending 30th June, 1905:—

Details of Cost of Gas.

Manufacturing costs—	s.	d.	s.	d.
Coal and oil	1	3½		
Wages and salaries	0	3½		
Purification	0	1		
Repairs and maintenance	0	4		
			2	0
Less received for residuals ..			0	8½
			1	3½

* Excluding interest on capital.

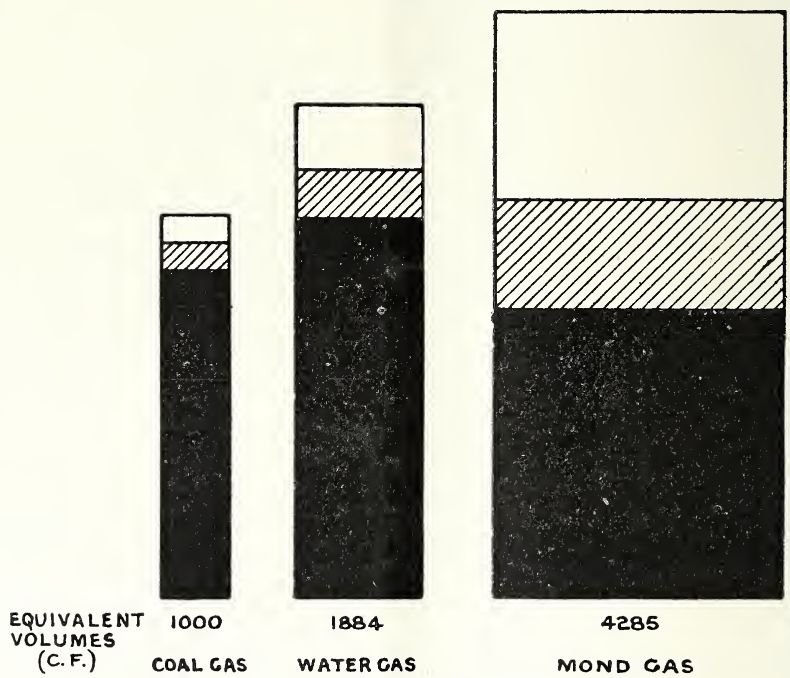
† How to prevent smoky fogs, p. 13.

Net cost of manufacture—				
Distribution	0	4		
Rent, rates, and taxes	0	3½		
Management	0	1		
Sundries	0	1		
			0	9½
			2	1
Less sundry receipts			0	1
			2	0
Gross profit			0	11½
			2	11½

the supply, so that the same gross charge may be spread over a larger volume of business. Experience shows that any reduction in the price of gas at once stimulates the demand, and there is good reason to believe that when, as in the case of the gas supplied by the South Metropolitan Company, the price is as low as 2s. per thousand, any further reduction will be followed by an extremely rapid extension of its use for cooking, heating, and power production.

A time-honoured institution like the coal fire will not be ousted all at once; but it

FIG. 5.



EQUIVALENT VOLUMES AND COSTS OF GASES.

The cost of London gas is undoubtedly high, and this is chiefly due to three causes:—

1. The large capital invested;

2. The requirements to which the gas has to conform, as regards illuminating power and freedom from sulphur, &c.;

3. The high price of coal.

Dealing with these in order, the large investment is the natural result of the slow growth of a great industry from small beginnings under changing conditions. The return on this capital, which for the year 1904-5 was only 3·85 per cent., cannot be regarded as excessive. The only hope of a reduction in this item of cost lies, therefore, not in any lowering of the dividends, but in an increase of

is significant of the hold which cooking and heating by gas have gained on those who have experienced their convenience that a Committee of the Pittsburg Chamber of Commerce, reporting in 1899 on the question of Smoke Prevention, expressed the following opinion:—"All indications point towards the permanent use of gas for all domestic purposes, even in the event that the supply furnished by nature should soon be exhausted."*

STANDARDS OF ILLUMINATING POWER.

The requirements to which the gas companies are subject as regards illuminating power date

* "Year Book, Chamber of Commerce." Pittsburg, Pa., 1900. P. 62.

from the time when, the light obtained from gas being derived from the gas itself by the incandescence of carbon particles, it was important that a due proportion of the constituents furnishing these particles should be present. Now, however, that the function of gas, as generally used for lighting purposes, is merely to heat a mantle to incandescence, the illuminating power loses its importance, and the restrictions which were originally adopted for the protection of the consumer now constitute a heavy and unnecessary tax upon him. Many of the gas companies are fully alive to this, and are doing their best to get the regulations modified to suit the conditions of the present day. Parliament has in several instances relaxed the requirements in question, the consumer reaping an immediate benefit in the reduction of the price of gas, generally to the extent of a penny for each unit of reduction in the candle-power. Within the past fortnight the Cardiff Gas Company have obtained a reduction of illuminating power from 16 to 14 candles, and in respect of this reduction have lowered the maximum price chargeable within the borough from 3s. 6d. to 3s. Reductions aggregating 2d. and 4d. respectively will take effect within the next few months. It is time that the general body of gas consumers woke up to the fact that some millions of pounds per annum are extracted from their pockets for which they receive no return, the sole justification for this extortion being that it enables a diminishing body of consumers to go on using their grandmothers' gas burners.

The Cost of Coal and Carriage.

It is the third question, however (namely, the high price of coal), which more nearly concerns us in considering the long-distance transmission of gas. The coal on hand in the Gas Light and Coke Company's yards at the end of June, 1905, was valued at 13s. 4d. per ton, and it is probable that this is not far from the average cost to the London and suburban companies of the coal which they use, delivered in their yards.

From an examination of various official returns and published prices, it would appear that the coal in question was not worth on the average more than from 6s. to 7s. at the pit's mouth, or one-half of its cost delivered to the retorts. It follows from this that carriage, handling and incidental expenses, account together for something like 6s. 8d. per ton of coal, which, allowing 10,000 cubic feet of gas per ton, works out at no less than 8d. per thousand cubic feet. It remains to be seen whether gas can be transmitted at a lower rate.

Amount of Gas Required.

The cost of transmission will depend very materially on the scale on which it is undertaken. I showed, in my "Smoke Prevention" paper,* that a supply of gas, equivalent in heating value to the 15,000,000 tons of coal consumed by the metropolis every year, can be conveyed from the South Yorkshire coal-fields (a distance of say 173 miles) by a single line of 6-foot pipe, with an initial pressure of 480 pounds per square inch, or, not to depend on a single main, by four lines of pipe ranging from 3 feet to 6 feet in diameter, with a pressure of 510 pounds. It would not, however, be necessary to supply so large a quantity, for gas, by reason of its higher practical efficiency, would take the place of a much larger amount of coal than would appear from a comparison of their respective calorific values. The actual amount of gas which would be required depends on so many conditions, the effect of which cannot be estimated with any approach to accuracy, that it is impossible to say even approximately what it is likely to be. In view of all the facts, however, it is reasonable to suppose that the consumption of gas in London might be increased to four or five times its present amount. Whether or not this rate is actually reached, or whether it is exceeded, the difference in the scale of operation will hardly be such as to make any material difference in the cost. For the sake of a tangible example, I have assumed a consumption of 180,000,000,000 cubic feet per annum, and a maximum demand of 900,000,000 cubic feet per day.

Cost of Transmission.

If it were necessary to keep down the cost of transmission to the lowest possible figure, the gas would be conveyed by a single line (or at most two) of steel pipes, increasing in diameter towards the point of delivery, so as to keep down the frictional loss, and to utilise the whole of the pressure for transmission. It will be prudent, however, to increase the number of pipes to four, and for reasons which will be apparent later on, it may be desirable to deliver the gas at a fairly high pressure. Each main would then be laid with 30-inch pipes throughout, the thickness varying from one end of the line to the other as the pressure

* "How to prevent Smoky Fogs," pp. 21, *et seq.*

dropped. The weight of gas conveyed per minute would be 4,637 pounds per main, or 18,548 pounds in all, being about 80 per cent. of the carrying capacity of the four mains, with initial and terminal pressures of 500 pounds and 250 pounds respectively.

The weight of each line would be about 82,000 tons, or 328,000 tons for the four, and their cost at current prices would be as follows:—

	£
Pipes, 328,000 tons at £15	4,920,000
Add for wrapping in tarred canvas, at £1	328,000
Cartage, at say 7s. 6d.	123,000
Jointing and laying, 3,680,000 feet at 1s.	184,000
Excavation, 1,226,667 lineal yards at 4s.	245,333
Valves, specials, &c., say	59,667
Engineering and superintendence, at 10 per cent.	586,000
Contingencies, at 10 per cent.	586,000
	£7,032,000

To this must be added Parliamentary expenses and cost of wayleaves, the amount of which it is exceedingly difficult to assess. By way of making some allowance for these items, I have carried in the round sum of £1,000,000, bringing the total initial cost to £8,032,000. Those who are better able than I am to gauge their probable amount will have no difficulty in making any correction which they may consider necessary.

Annual Cost of Transmission (exclusive of compression).

	£
Interest on £8,032,000 at 6 per cent.	481,920
Depreciation on £7,032,000 at 4 per cent.	281,280
Inspection and repairs, say	10,000
Rates and taxes, say	5,000
	£788,200

Power for Transmission.

To compress the maximum supply of 625,000 cubic feet of gas per minute to a gauge pressure of 500 lbs. per square inch, requires about 207,000 indicated horse-power. Under ordinary circumstances this power would be most economically obtained by means of producers and gas engines, which at 0·8 lbs. of coal per indicated horse-power per hour, would consume some 355,000 tons per annum. There is little doubt that this is much less than the amount of coal consumed by all the coasting steamers, goods and shunting engines which now carry the coal supply of London. In the present case, however, there happens to be a source of power already available in the gases of combustion from the coke used for carbonising the coal. These gases leave the retort ovens at a very high temperature, the greater part, if not the whole, of the heat which they contain being generally wasted, whereas by means of suitably arranged boilers they might be made to furnish most, if not all, of the steam required to work the compressors.

The power plant might be conveniently arranged in units of 5,000 horse-power each, each colliery which feeds the line having its own compressor station, containing as many units as might be required. The compressors should be direct-driven, and, to avoid unnecessary loss of power, should work in three stages. To secure the highest economy, condensing engines might be used, but under the circumstances of the present case it is doubtful whether the reduction in steam consumption would be of sufficient importance to justify the increased initial outlay. Moreover the steam from a non-condensing plant need not be wasted, but might be used to manufacture water gas; and bearing in mind the small proportion (less than one-fifth) of the heat of the steam which the best engine can turn into power, it will be seen that the value of the steam for gasmaking purposes will not be greatly reduced by its previous utilisation in the engines.

In view of the unusually large scale of the power plant, and the consequent lack of data on which to base an estimate, the following particulars of initial and working expenses have been specially obtained from a leading firm of engine builders:—

Cost of Compressor Plant of 206,875 i.h.p., or, Adding 20 per cent. for Reserve, say 250,000 i.h.p.

	£
450 boilers, each evaporating 10,000 pounds of water per hour, including setting; 75 feed pumps; fifty 5,000 h.p. direct-driven compressing engines, steam-pipes, &c.; 10 travelling cranes; buildings, flues and stacks	2,014,000
Land, roads, &c., say	83,200
Engineering and supervision, 10 per cent.	201,400
Contingencies, 10 per cent.	201,400
	£2,500,000

Annual Cost of Compression.

(Raising steam with waste heat from retort settings.)

	£
Interest on £2,500,000 at 6 per cent.	150,000
Depreciation and repairs, £2,014,000 at 5 per cent.	100,700
Attendance on boilers and feed pumps (stoking charged to retorts)	3,750
Engine-room staff, 42 units at £250......	10,500
Oil and waste, 42 units at £130	5,460
Management, 10 stations at £600........	6,000
Sundries, say	13,590
	£290,000

Spreading the annual costs of compression and transmission over 180,000,000,000 cubic feet of gas, they work out as follows:—

			d.
Compression ..	£290,000	=	0·39 per 1,000 c.f.
Transmission ..	£778,000	=	1·04 ,, ,, ,,
Together .	£1,068,000	=	1·43 ,, ,, ,,

Taking the value at the pit's mouth of the coal consumed in London at 8s. per ton (the average for 1904 being 7s. 1d.*) and the average price paid by the consumer at 20s., the cost of conveying and distributing the annual supply of 15,000,000 tons works out at £9,000,000. In comparing this cost with that of gas transmission, it should be borne in mind that the calorific value of the gas in question is barely one quarter that of the coal. It is apparent, however, that, whatever estimate may be formed of the relative efficiencies of coal and gas, there will remain a substantial margin in favour of the latter.

As compared with the 8d. per thousand cubic feet which it costs to convey coal for gas-making purposes, gas transmission shows a saving of 82 per cent.

In this connection it is interesting to note that the manager of the Western United Gas and Electric Company, of Illinois, estimates the cost of transmission within his district at 1½d. per 1,000 cubic feet. Working on the lines set forth in my Smoke Conference paper,† the cost per thousand would have been ¾d. The larger amount of the present estimate is due, partly to the smaller scale of operation, but chiefly to the high terminal pressure adopted, which necessitates not only an additional pipe line, but also a much greater thickness in the pipes towards the London end.

* "Mines and Quarries: General Report for 1904," p. 195.

† "How to Prevent Smoky Fogs," p. 24.

Utilisation of Terminal Pressure.

The considerations which justify this increased expenditure are as follows:—In transmitting air or gas in pipes there is very little gain in utilising the whole of the pressure for transmission, because by expanding the gas down to atmosphere we increase its volume, and consequently its velocity, to a very great extent. It follows that the frictional losses in the last few miles of pipe are enormous, involving a corresponding drop of pressure in this part of the main. By delivering the gas under pressure, this wasteful expenditure is avoided, and although the amount of gas delivered is, of course, reduced, a simple calculation shows that this reduction is very slight in comparison with the pressure saved. On the other hand, the residual 250 pounds of pressure represent some three-quarters of the effective work of compression, and by means of suitable engines or motors, such as are used with compressed air, may be made to restore a great part of the power which was expended in this operation.

Generation of Electricity.

To compress 1,000 cubic feet per minute to a pressure of 500 pounds, with the moderate total efficiency of 69 per cent., requires the expenditure of 331 indicated h.p. By utilising the expansion of the gas, from 250 lbs. down to atmosphere, without addition of heat, in a suitable engine with direct-coupled dynamo, some 10 kilowatts would be obtained per 1,000 cubic feet per minute, or from the daily supply of 900,000,000 c.f.d., say 1,000,000 kilowatt hours. This is on the assumption that the gas expands adiabatically, in which case it would emerge from the motor at a temperature of about 200° Fahr. below zero, and with only one-half its normal volume. It will therefore be desirable to heat the gas before it enters the motor, for which purpose from two to three per cent. of the expanded gas may economically be utilised. The power developed may thus be increased by something like 50 per cent., giving a daily output of, say, 1,500,000 kilowatt hours (Board of Trade units). This, at ¾d. per kilowatt hour would give a daily revenue of about £4,700, of which station costs would probably absorb one-third; and interest, depreciation, and management another third; the amount of these charges depending on the load-factor obtained.

It might not be convenient so to arrange the transmission of the gas that the whole of the current generated therefrom could at

all times be utilised; but there is little doubt that the profit on the year's working would yield a handsome return on the cost of maintaining a high terminal pressure.

Ice Manufacture.

It was mentioned above that if the gas were used for power production without being heated it would emerge at a temperature of – 200° F. The gas would in practice pick up a certain amount of heat from the walls of the cylinder, and the final temperature would consequently be higher; but it would in any case be far below zero. Extreme cold has its value as well as heat, and in the present case the emerging gas might conveniently be used for the manufacture of ice. Making the necessary allowances as regards efficiency, a ton of the best ice, for which a wholesale dealer would pay about 10s., can be made for each 125,000 cubic feet of gas. Working expenses, depreciation, and interest on cost of plant would absorb say 4s., leaving a net profit of 6s. per ton. If the whole of the gas were used in this way, and none of it were heated before use in the motors, the yearly production of ice would be 1,440,000 tons, a quantity for which it would not be easy to find a market. A part of the cold produced by the expansion of the gas might therefore be utilised by means of cold storage chambers, an extended provision of which might be welcomed by those who view with suspicion the addition of preservatives to food.

Effect of Transmission on Cost of Manufacture.

In considering the question of removing the manufacture of gas from the metropolis to the coalfields the question of the effect of the change on the cost of manufacture will naturally come up. The first consequence obviously will be the saving of the cost of the carriage and handling of the coal, less that of compression and transmission. A second result of no mean importance will be the utilisation of the dust and small coal which will not bear the cost of transport, but which nevertheless are perfectly suitable for gas-making. As a matter of fact the South Metropolitan Gas Company at the present time use a grade of coal which has generally been looked upon as inferior, and which apparently approaches in quality the waste coal now in question. Of the money value of the latter various estimates were given before the Commission. One witness spoke of the fuel in the Mond Producer as "common small coal which would be worth 3s. to 4s. per ton at the pit's mouth" (R.C. 14,811). Another, speaking of the value of colliery waste, estimated it at "perhaps 1s. 6d., 1s. 9d., or 2s. per ton" (R.C. 16,429). There seems to be little doubt that a very large quantity of this material, well suited in all respects for gas-making, could be had at say 3s. per ton. It must, however, be borne in mind that this small coal is merely the waste arising from the getting out of the marketable sizes, and that, if gas transmission came to be generally adopted, the production of these grades would fall off to a very considerable extent. The small coal consequently would no longer be obtained as a by-product, but would have to be mined on its own account, in which case its cost would lose the benefit which it now derives from the high prices commanded by the better grades. In view of this consideration, and the advisability on general grounds of understating rather than overstating the case in favour of gas transmission, I have estimated the cost of the coal to be used for gas-making at 6s. per ton. A very large amount of gas, however, is already produced in the ovens in which coal is carbonised for furnace and foundry use. The quantity of coke made every year for this purpose is variously estimated at from 10,000,000 to 12,000,000 tons, representing an annual consumption of from 17,500,000 to 21,000,000 tons of coal. Ninety or 95 per cent. of this coke is made in "non-recovery" ovens, that is to say, the whole of the gas and other by-products are wasted. If these ovens were suitably arranged for the recovery of the gas, as some of the witnesses suggested, practically the whole of the supply above proposed for London would be obtained without carbonising a single ton of coal for the purpose. As previously mentioned, the exhaust steam from the compressor engines would also be available for the manufacture of water-gas, of which it would yield far more than could easily be utilised.

The supreme importance of gas transmission from a coal conservation point of view lies in the opportunities which it affords for uniting into one family the whole circle of coal-consuming processes. Each of these processes, when carried on alone, takes its *quantum* of coal, appropriates what it wants from it, and rejects the rest. Co-ordinating them, as above proposed, the waste of each process would furnish the material needed for the next, thus bringing into play a long chain

of economies, the full effect of which it is not easy to grasp.

For the present I will leave these far-reaching economies out of sight, and deal with the question simply as one of gas manufacture. Taking the cost of coal, then, at 6s. per ton, the next step is to ascertain the cost at which gas can be made. This question is far too intricate to be definitely dealt with by an estimate, even if my technical knowledge were sufficient to justify me in forming one. I propose, therefore, to take the cost of gas as now manufactured in existing works, merely substituting 6s. per ton for the actual cost of the coal used at each.

serious proportions; but of late years considerable improvements have been made. Professor Unwin, in his Howard Lectures, cites a test of a four-mile line of air main at Offenbach which showed a leakage of only 1·6 cubic feet per mile per hour. The pipes were smaller than those now in question, and the pressure less than we propose to employ; but making the corrections necessary on this account, the total leakage from our four lines of pipe will be a small fraction of one per cent. of the gas conveyed. The chief loss will occur in the distributing system, the percentages unaccounted for in the case of the three London companies being 4·3, 5·3,

Net Cost of Maunfacturing Gas at various Works, taking cost of Coal at 6s. per ton.

	Colne Corporation.	Leigh Corporation.	Widnes Corporation.	Stourbridge U.D.C.	Wigan Corporation.	Lancaster Corporation.
Cubic feet made per hour	10,809	11,050	9,815	11,224	11,384	10,531
Actual net cost of gas in holder	s. d. 0 8·04	s. d. 0 7·62	s. d. 0 4·90	s. d. 0 9·87	s. d. 0 5·78	s. d. 0 7·74
Actual cost of coal per ton	11 $0\frac{3}{8}$	11 $1\frac{1}{2}$	8 $4\frac{3}{4}$	13 $5\frac{2}{3}$	10 $1\frac{5}{8}$	11 $11\frac{7}{8}$
Cost of coal less 6s. ..	5 $0\frac{3}{8}$	5 $1\frac{1}{2}$	2 $4\frac{3}{4}$	7 $5\frac{2}{3}$	4 $1\frac{5}{8}$	5 $11\frac{7}{8}$
= per 1,000 feet	0 5·59	0 5·55	0 2·93	0 7·99	0 4·36	0 6·83
Corrected cost of gas ..	0 2·45	0 2·07	0 1·97	0 1·88	0 1·42	0 0·91

Average 1·78d.

The corrected cost of gas at Lancaster comes very near the lowest cost of which I have any record, viz., 1d. per 1,000 cubic feet, the gas in the case in question being obtained as a by-product at some chemical works. I propose to take the average figure arrived at above, viz. 1·78d. per 1,000, as our provisional net cost of manufacture. £30 per thousand cubic feet per day is a liberal estimate for manufacturing plant, the interest on which at 6 per cent. comes to 36s. It has been stated that with proper attention to repairs no allowance need be made for depreciation; but to be on the safe side 2 per cent. may be set aside for this purpose, which will replace the cost of the plant in twenty-eight years. With interest and depreciation together amounting to 48s., and an output, per thousand cubic feet maximum capacity, of 200,000 feet per annum, these charges work out at 2·88d. per thousand cubic feet. Management and rates and taxes I have provisionally set down at one penny per 1,000.

Leakage.—In the case of some of the older pipe-lines the loss by leakage assumed very

and 6·3 respectively. An allowance of 10 per cent. should be ample to cover leakage from both the transmitting and the distributing systems.

To arrive at the price at which gas might be expected to be delivered to the consumer, it remains to add the cost of distribution and management and the companies' profit. The gas now supplied to London costs about £364,000* per annum to distribute, and the existing mains are probably capable of conveying, at pressures not exceeding those used in some other towns, the whole 900,000,000 cubic feet per day. If, however, we allow for distribution twice the above-mentioned figure, it works out to 0.97d. per thousand cubic feet. With no manufacturing plant to look after, the £782,000* per annum now set aside for management, rates and taxes, bad debts and miscellaneous expenses should continue to cover these items. Spread over 180,000,000,000

* N.B.—In the absence of full information as to the details of cost in the case of the smaller companies, the figures given in this paragraph are taken as proportionate to those reported by the three largest companies.

cubic feet it works out at 1·04d. per thousand, while the gross profit of £1,638,000* now earned by the companies comes to 2·18d.

ULTIMATE COST OF GAS IN LONDON.
PROVISIONAL ESTIMATE.

(On basis of 10,000 cubic feet made per ton of coal.)

		d.
Net manufacturing cost at pit's mouth, per thousand c.f. made, taking coal at 6s. per ton (obtained from average of six lowest actual costs)		1·78
Interest on cost of manufacturing plant, 6 per cent. on 3s.		2·16
Depreciation, 2 per cent. on 3s.†		0·72
Management, rates and taxes, say		1·00
Cost of gas delivered to Compressors		5·66
Compression	0·39	
Transmission	1·04	
		1·43
Cost of gas per 1,000 c.f. delivered in London		7·09
Allowance for leakage in course of transmission and distribution 10 per cent. of total adding 11·1 per cent. to above		1·79
Cost of gas per 1,000 c.f. sold		7·88
Distribution (twice present cost of distribution)	0·97	
Management, at present amount	0·24	
Rates and taxes ditto	0·57	
Bad debts ditto	0·02	
Miscellaneous ditto	0·21	
		2·01
Profit ditto		2·19
Ultimate selling price		12·08d.

Grouping the various items of cost into one statement, it appears that on the basis described gas might be delivered to the present gasholders for just over 7d. per thousand cubic feet, and sold to the consumer at about 1s. In arriving at these figures the profits from the sale of current and of ice have not been taken into account, but they would probably go far towards covering the cost of transmission.

OTHER POSSIBLE ECONOMIES.

Other factors which would come in to reduce the cost of production, and of which no account is taken here, are the abolition of standards of illuminating value, such relaxation as may seem advisable in standards of purity, the combination of the manufacture of furnace coke with that of the gas, the utilisation of the steam from the compressor engines for the production of water-gas, and others which will readily occur to the gas engineer. Any of these factors, acting alone, would bring about an appreciable reduction in the cost of the gas; together they would admit of a very considerable lowering of its price. I have taken no credit for them, because, in the first place, it is difficult to forecast their effect; secondly, however carefully an estimate of expense may be prepared, it is always possible in dealing with a complicated matter like the present that some item of cost may be overlooked; and thirdly, it is not my object to cut down my estimate of the price of gas to the lowest possible figure, but merely to demonstrate that by working on the lines indicated its present price may be substantially reduced. It may not be amiss to point out that the full reduction could not take effect immediately, inasmuch as it is contingent in part on a fourfold increase in the present consumption. There can be no question, however, that the reduction of the price of gas to anything like 1s. 6d. per thousand would bring about so large an increase in the demand that further reductions would speedily ensue, with the result that nearly the whole of the coal at present consumed in London would be displaced by gas. Even for the generation of electricity, gas at 1s. 6d. would cost less than the coal now consumed by twenty-three out of the twenty-five Metropolitan electrical undertakings, while Hackney's fuel bill (the lowest of them all) exceeds the equivalent of gas at 1s. These undertakings, however, would probably find it cheaper to obtain their current from the gas expanding stations than to generate it themselves.

INCIDENTAL CONSEQUENCES OF GAS TRANSMISSION.

Turning now to the incidental consequences of gas transmission, and giving due precedence to the fog question, the general supercession of coal by gas would put an end, once for all, to the smoke nuisance, and the abnormal blackness and persistence of the London fog would become a memory of the past. Although for the sake of definiteness, I have hitherto dealt with the matter solely in its relation to London, there is no reason why gas should not be piped in the same way to every city and town in the kingdom. To inland towns indeed, which pay 18s. or 19s. for their gas coal, cheap gas would be an even greater boon

* N.B.—In the absence of full information as to the details of cost in the case of the smaller companies, the figures given in this paragraph are taken as proportional to those reported by the three largest companies.

† 2 per cent. per annum invested at 4 per cent. will replace capital in 28 years.

than to London, with its sea-borne supply. Nor need the benefits of cheap gas be confined to the towns, for there is no reason why the trunk mains should not be tapped at any desired point along the route. The cause of industrial decentralisation could be given no greater stimulus than it would receive from the provision of light, heat and power at a minimum cost along every foot of the pipe-lines from the collieries to the metropolis.

The benefit which would accrue to the wheat-growing industry from an abundant supply of sulphate of ammonia has already been referred to; but it is probably hardly greater than those which the country at large would derive from the concentration of the production of gas-tar (now scattered over a multitude of small works) in the coalfields, where, with power and heat at their lowest cost, the British manufacturing chemist would have every advantage in winning back our lost coal-tar industry.

It is possible that the railway companies may not at first sight welcome a change which, carried out in its entirety, would put an end to the conveyance of coal by rail; but for the loss which they sustain in their capacity of coal carriers they may derive some compensation from the supply of cheap gas at a pressure at which a receiver of the same size and shape as the present locomotive boilers will hold enough to haul an express train a hundred miles. The compressed gas will also be available as a fuel for motor cars, for which purpose fourpennyworth of gas at 1s. 6d. per thousand cubic feet are more than equivalent to a gallon of petroleum.

In dealing in a paper like the present with so vast a subject, I am fully conscious that I have left much undone which might fairly have been demanded of me. Had time permitted, I should have liked on the one hand to have traced still further the consequences of my proposals, and on the other, I might have set out for your scrutiny the long chains of calculations by which my conclusions have been arrived at and verified. Whether or not my proposals are accepted in their entirety, is a matter in which I feel no great concern, for however you may disagree with me as to details, I trust you will support my three main conclusions, viz., that no time should be lost in taking effective measures for the conservation of our coal resources, that the best hope of effecting substantial economies in consumption lies in the prevention of overlapping wastes by the co-operation of various classes of consumers, and that in all coal-consuming establishments systematic provision should be made for recovering the valuable by-products.

It was announced in the House of Commons on Monday that the question of the most suitable means of supplying electrical energy to London would shortly be referred to a Committee. It is earnestly to be hoped that the matter will not be dealt with in any narrow spirit, but on broad and statesmanlike lines.

I have, in conclusion, to acknowledge my indebtedness to all those who have so kindly supplied me with data for use in the preparation of this paper.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that speaking generally the question of prevention of smoke in London was of very great importance to every individual, but it remained to be seen whether Britishers were as far advanced as they ought to be in giving up the pleasures of their open fire-places. He had no doubt that those present sat down after dinner in front of the fire to warm their toes, and every now and then to poke the fire. But in doing so they never thought what was taking place in the chimney-pot, which emitted every time the fire was poked a vast amount of smoke and many blacks. In order to avoid making black fogs in London, it was necessary, in the first place, to give up open fire-places, which, if they were modified to some extent, would reduce the amount of smoke they produced; but any alteration in them would not altogether get rid of the smoke-producing properties they possessed. There was no donbt that, in order to clear the atmosphere of London, the adoption of gas fuel was an absolute necessity, but it was a question whether gas could be burnt in such a way in gas stoves as to give the heating power required at a reasonable cost. The author had thrown out some most valuable suggestions in regard to the supply of cheap gas, which he thought could compete with coal burnt in open fire-places. He had no doubt that the considerable amount of heat which went up chimneys at the present time could be reduced by the adoption of stoves burning coal-gas. His own office was unbearably cold before he adopted a stove, but it was now comfortably warmed by the combustion of the same amount of coal which he previously burnt in an open fire-place. He also adopted a stove in his house which warmed the whole house and burnt less coal than the open fires previously used. But by the adoption of coal burning stoves the atmosphere of London would not be cleared, and if that was to be done gas stoves placed in rooms must be adapted in such a way that the largest amount of heat was taken out of the gas and transmitted into the air of the room, economising the gas, and thus not incurring an excessive cost in using that form of fuel. The question immediately under discussion

was whether the gas should be produced at the coal-fields or in the vicinity of London at a price to meet the requirements. If it was produced in the vicinity of London, there was no reason why the atmosphere of London should be blackened, because, owing to legislation, the combustion of coal was now so perfect with mechanical stokers that it was very rare for black smoke to be seen at the top of chimneys; indeed, it was only due to carelessness if smoke was allowed to come out of the chimney of a factory if a proper mechanical stoker was used. Coal-gas, owing to the adoption of mantles, could now be produced more economically, because, as had been explained by the author, the adoption of oil for the purposes of increasing the illuminating power of the gas was now not so important as it used to be before the mantle was adopted, and they used their "grandmothers' burners." It was, however, a difficult question to decide whether coal-gas could be compressed to a pressure of 500 lbs. per square inch, and transmitted economically in a pipe line to London, because a large portion of the gas, being hydrogen, found its way through the very smallest leakages in the pipes. They had found that to be the case in America, where the pressure did not go above 300 lbs. per square inch, and it had been necessary to surround the pipe line with another pipe, so that the leakage would be caught and pumped back into the gas mains. The gas in America was natural gas, and had been used by the Americans in the most prodigal manner. The leakage in the main had also been very considerable, and it was a very moot question whether gas could be transmitted in the manner suggested by the author. Nevertheless, the principle on which Mr. Martin had been working was in a measure not upset by that difficulty, because gas could be produced in the neighbourhood of London and transmitted for the purposes required. Up to the present time, legislation had gone a long way towards reducing the amount of smoke emitted; and besides reducing the smoke emitted by factories both the District Railway and the Metropolitan Railway had been electrified, and the smoke produced by the railways, which was formerly perfectly unbearable, had now been entirely done away with. Up to the present, however, there had been no legislation with reference to domestic smoke. It was at the present time necessary, in order to obtain the assistance of the law, to prove a nuisance, and that was practically impossible with regard to smoke emitted by private houses. The County Council seemed to have gone into the matter very carefully, and the annual report of the Officer of the Public Control Department of the Council in September 1904 stated, amongst other things, "The Public Control Committee will shortly have the whole question of domestic smoke under consideration in order to see whether measures can usefully be taken." That distinctly showed that the County Council was considering the matter, and he sincerely hoped they would carry their consideration further, and he hoped that the suggestions made by the author would receive consideration.

Mr. W. D. Scott-Moncrieff said it was twenty-five years ago last December since he read a paper at the Society of Arts on the subject of doing away with the nuisance of smoke in London, the chair being occupied at the meeting by Sir Robert Rawlinson. The proposal at that time which received the greatest attention was that made by Sir William Siemens that coke should be used in domestic fires, and it was suggested that as coke was rather difficult to light, and did not give a very cheerful appearance, it should be supplemented by the use of gas. That proposal had been again revived, and was referred to at the recent conference on the subject of Smoke Abatement. It was the belief of a great many persons that, somehow or other, the domestic grate might be so altered or improved that ordinary bituminous fuel could be used in it without giving rise to any nuisance in the way of smoke. The position he took up at the time was that if the blast furnace, with the enormous temperatures available, was incapable of consuming anything like all the gases made in the production of iron, it was exceedingly unlikely that any amount of ingenuity expended upon a domestic grate at lower temperatures, and without the same facilities, could possibly be successful. The passage of the twenty-five years since he read his paper had produced the condition that any hopes with regard to the improvement of the domestic grate had been entirely dissipated, and most people agreed that bituminous coal could not be burnt in a grate, and be practically smokeless. The proposal at the time was that the existing gas companies had a sufficient amount of plant available for doing what was necessary if they extracted only 3,000 cubic feet of gas per ton out of their coal, instead of 10,000 cubic feet, as this would give rather more than three times the amount of fuel available in the form of coke. Sir Robert Rawlinson, who was at the time a director of the Phœnix Gas Company, requested the manager to make some experiments in that direction, but it was found that the practical difficulties in the way of carrying out such a scheme were insurmountable, because at the period of extraction represented by 3,000 cubic feet of gas, a great nuisance would have arisen from the escape of large volumes of smoke from the retorts. As a matter of fact no evidence had been available to show how far such a scheme was really impracticable; and if it was the case that it would provide a remedy, it would be quite worth while to attempt to discover whether the difficulties were insuperable. He pointed out at the time that fuel resulting from an extraction of 3,000 feet instead of 10,000 feet of gas per ton had 20 per cent. more calorific value than the latter; but he did not think any estimate had been made of the calorific value of coal during different periods of extraction.

Although it was difficult to get such a scheme as he proposed carried out without funds available for the purpose, it must be remembered that the gas companies at that time were more prosperous than they were at present and paid handsome dividends; but they were in a different position now, and were making great efforts to improve their dividends by taking an intelligent view of all proposals brought forward with any prospect of success. With regard to the details of the paper, he considered that a pressure of 500 lbs. per square inch upon four pipes running from the Midlands was a very heroic proposal; and if leakage occurred in America with only 300 lbs. pressure, the leakage arising from 500 lbs. pressure would not only be greater, but the technical difficulties of producing the pressure would be enormously increased.

Sir H. T. WOOD (Secretary) thought it would be of interest in connection with the last speaker's remarks if he stated that Sir William Siemens designed a stove which had been working, for the last twenty years, in a most satisfactory manner in the Secretary's office at the Society of Arts. It was intended to burn gas and coke, but as a matter of fact coal was always used. The stove was most economical and convenient; neither wood nor paper were used in lighting it, a little coal being put in and the gas then turned on. It was probably only due to the fact that the stove was not patented, and that nobody had "pushed" it, that it was not at present the most popular stove in existence, instead of being represented by the one solitary example in his own room.

Mr. M. A. ADAM said that the transmission of gas seemed to resolve itself into a question of loss by leakage. The Chairman had suggested as an alternative, that, instead of the transmission of gas, the transmission of coal would not be so serious a problem. If he remembered rightly, the figures quoted for the price of coal in connection with the Administrative County of London Electric Power Bill in the course of last year were somewhere between 6s. 6d. and 7s. 6d. per ton delivered in London. If the transmission of coal to London was as cheap as that, it was a serious question whether anyone could reasonably support a scheme for the transmission of gas at high pressure, with all its attendant difficulties. The author had suggested several devices for the utilisation of the gas at the receiving end; for instance, the running of motors from a high pressure gas supply resulting in an expansion down to temperatures below freezing, and the utilisation of the cold gas for the purposes of obtaining ice. In his opinion, those schemes were impracticable. He did not know whether the author had studied what would happen in the case of the expansion of the gas at those low temperatures, having regard to the hydro-carbons carried in the gas. His own impression was that large deposits would take place, which would have a serious effect on the utilisation of the gas in motors. One feature in favour of the proposal for transmission of gas was the concentration of all the generating apparatus in one centre, which undoubtedly lent itself to a very great conservation of valuable forces and therefore effected great savings; but he doubted whether those savings would pay for the losses which must take place in transmission. The figures which the author had given for the price which would be charged for the gas at the delivery end were not very different from those which had been advocated by many people as possible with the existing gas companies if the limit as to the illuminating value of the gas was removed. His partner, Mr. Dugald Clerk, had been pressing for many years for the removal of that limit, which would be a very great benefit to the community, and the figures which he had mentioned in various papers that the gas companies should aim at were the very figures mentioned by the author, namely, 1s. and 1s. 6d. per thousand. As a matter of fact, coal-gas was now supplied in England at 1s. a thousand feet at Widnes, Sheffield, and other places, and that was another reason for doubting whether transmission of gas under pressure was desirable if the margin was so small. Even in London, the South Metropolitan Company supplied gas at about 2s. per thousand feet, which was not very much greater than the 1s. 6d. mentioned by the author, and that in face of the difficulty that they had to supply the gas of a fixed illuminating value.

Dr. F. H. BOWMAN said that smoke could be absolutely prevented if everybody made up their minds to do so. He could stoke a boiler without mechanical means, and not make any smoke after the fire had been got up, but the moment he handed over the charge of the boiler to somebody who did not understand the question, a nuisance was immediately caused by the smoke. The question of the production of heat was a very important point in a large number of industries. The best effects could only be obtained where the gas was produced at the point where it was used immediately along with the heat given off by the products of combustion; if it was cooled down and carried a distance, such a large portion of its effect was lost that it would not pay for the transmission. It might be taken for granted that, for metallurgical and other processes, for a long time to come the gas must be produced at the point where it was utilised if the works were to be run economically. The introduction of the transmission of power had revolutionised the question of the distribution of gas. Even if he gave 24s. and 25s. a ton for coal, he could produce in heat units gas cheaper than the cheapest gas mentioned by the author, transmitted over a distance. In the transmission of gas, one thing which would occur was that it could not always be utilised exactly at the time it was produced, and to produce gas cheaply the process must be continuous and not intermittent. An immense quantity of storage would be required

for a pipe system, and that would be a very serious drawback. Anyone who had studied the question of the ballistic qualities of gas knew that if it was compressed to the pressures named a very large proportion of the volatile and other valuable constituents both for heating and lighting would be thrown down in the form of liquid, and difficulties of a chemical nature would arise which would make it impossible to deal with the matter. The author had stated that he hoped gas might be delivered at 1s. a thousand cubic feet. In his own case he put down a gas plant, and when he had sold the residuals for use in his own works he produced gas of 14 candle-power at less than 1d. a thousand cubic feet. He offered to supply a neighbouring village with that gas; but as the authorities there had a gas plant of their own, they refused his offer because they thought it would interfere with their monopoly. At a properly constructed works, it was quite possible, with the present price of coal, to produce gas at a cheaper price than 1s. a thousand feet, even in London.

Mr. Bennett Brough thought in his statement that at no very distant date a cheap and abundant supply of coal would have become a thing of the past the author had perhaps taken too pessimistic a view of the future of British coal supplies. Mr. Martin had quoted the figures given by the Coal Commission, but did not state that these figures were 10,000,000 tons more than the estimate made by the previous Commission in 1871, so that if another Commission was held 25 years hence, another 10,000,000 tons would probably be again added to the estimate. It must also be remembered that the Commissioners' estimates paid no heed whatever to any coal below a depth of 4,000 feet, and as in the Lake Superior copper mines copper was now being produced in large quantities from a depth of 5,000 feet, it was quite possible that, in the course of time, the extra depth of 1,000 feet in the coal supplies of the country would be worked. In his remarks on the wastefulness of present modes of consumption the author made no reference to the very great economies in coal consumption which had been effected in the iron industry. In 1871, 30 per cent. of the coal consumed in the country was used in the iron industry, whereas at the present time it was only 15 per cent., due to the introduction of improved methods. At the present time the railways of the country used 8 per cent. of the coal consumed, but if electrification became more general it would have the tendency to reduce considerably that proportion. In all directions economies in fuel were to be noticed; and in urging the immediate adoption of effective measures for the conservation of our coal resources, the great progress already made should not be ignored.

Dr. Leonard T. Thorne said that 25 years ago he took up the question of the production of gas, not at the mouths of the pits, as Mr. Martin had done, but with regard to the utilisation of the gas made in the present works. He thought a great deal of the criticism of the author's figures had been rather exaggerated. The figures seemed to have been worked out carefully, and were based in all cases on a maximum of 1s. a thousand feet, which, in his opinion, could be considerably reduced. Gas was now being made in London at a very much lower figure, though the consumers in London, up to the present, had not obtained any benefit by a reduction in the price of gas. In Widnes, Sheffield, Sunderland, and other places where the gas was very low in price, the companies had the advantage of making the gas practically at the pit's mouth, and the question of transport did not arise. One speaker had mentioned that it was suggested that coal could be obtained in London at 6s. 6d. and 7s. 6d. per ton. He did not think there were many manufacturers in London who were in the happy position of being able to get coal at that price. His own firm consumed 700 or 800 tons of coal per week, at an average cost of 13s. 6d. or 14s. 6d. per ton. The author had estimated that he would save five, six, or seven shillings in the transport of the coal; and if the figures were carefully gone into it would be found that the figure of 6s. 8d. given would not be very much above the extra price paid in London for coal compared with the price paid at the pit's mouth. He quite agreed with the remarks which had been made as to the practical difficulties of transmitting gas over long distances at very high pressure. There had been considerable leakage where natural gas was transmitted. In natural gas the main proportion of the gas was marsh gas, which had a density of something like eight times the density of hydrogen, which formed 40 per cent. of coal-gas, and that would prove a greater difficulty, from the leakage point of view, than had been anticipated. The methods of transmission, however, had been greatly improved, and rendered the prevention of leakage much more possible than was the case years ago, and it was within the bounds of possibility at no very distant date that means would be found which would very much reduce the leakage, and in that case the author's proposal might be favourably considered from an economical point of view.

Dr. Rideal thought the question whether leakage could be satisfactorily overcome, was an engineering problem. Most people were agreed that gaseous fuel in some form had considerable advantages, especially when a reduction of illuminating power would enable the gas manufacturer to produce a gas of greater volume at a cheaper cost. Gas of low illuminating value would have a calorific value not proportionately reduced compared with the higher illuminating value, and would be capable of compression to the high pressure suggested by the author without losing its volatile constituents, and therefore would be capable of being transmitted in the way suggested.

Mr. MARTIN, in reply, said he should be the last to deny that novel and radical proposals of the nature he had put forward had special difficulties of their own. There had undoubtedly been a large amount of leakage in transmission systems hitherto, but very great improvements had been made in pipes since then; and although, as the Chairman pointed out, the pressures proposed were much greater than the pressures which had been worked with in the past and the leakage would be greater not in proportion to the pressure but in proportion to the square root of the pressure on the other hand the greater pressures enabled very much larger quantities to be transmitted; therefore, although there was a greater absolute leakage, yet the percentage of leakage was not necessarily larger than with lower pressures. The main fact to which he desired to draw attention was that, in spite of the difficulty which had been referred to, gas was still supplied under heavy pressure. With regard to the question of deposits raised by Mr. Adams, he quite recognised that if they worked with such gases as had been used in the past—gases which depended for their luminosity on a certain proportion of complex hydro-carbons—deposits of a serious nature would probably occur; but that point had been answered to a certain extent by Dr. Rideal, who pointed out that the calorific value of a gas was not necessarily dependent on the comparatively small proportion of the higher carbon compounds which gave the gas its illuminating value. They might even have a gas consisting of hydrogen, marsh gas, and carbonic oxide, all gases of very high calorific value, but which he did not think anyone would suggest were likely to lose anything by deposit under such conditions as those which had been referred to. Mr. Adam had raised the point that the suggested proposals did not offer any very great advantages in regard to the price of gas above what had been proposed in the case of gas generated in London, and had said that if the regulations fixing the illuminating power of the gas were removed, the gas already in London might be sold at a very much lower price. That was so, but it was not fair to compare London-made gas with the restrictions removed with pit-mouth gas made under the restrictions in force at the present time. If the saving in the cost of manufacture of the London gas was to be deducted, it must also be deducted from the cost of the pit-mouth gas. He quite agreed with the remark which was made that, for metallurgical processes, the highest economy would be obtained when the gas was produced near the point at which it was utilised. He did not think anyone would entertain a proposal to make gas for blast furnace or foundry use except close to the point at which it was required, but he thought it would be admitted that a very different set of conditions existed where gas had to be supplied for power production and for domestic use. He agreed with the suggestion that the figures he had given were not tempting. If he had desired to write a sensational paper, many of those figures could have been cut down from 20 to 50 per cent. For instance, he had taken the net cost of manufacturing gas at the pit's mouth at $1\frac{3}{4}$d. per 1,000 cubic feet, whereas Dr. Bowman had stated that he had made 14 candle-power gas from expensive coal at less than 1d. per 1,000 cubic feet; so that if the matter was gone into closely it would be found that the cost of 1s. per 1,000 feet delivered in London might admit of a very considerable reduction. The engineer of the Mond Power-Gas Corporation had called on him and complained that the figures in the paper for the cost of Mond gas were excessive, but, while they were possibly high, he (Mr. Martin) did not think they were out of proportion to the costs he had assumed for coal-gas. He also stated that the costs of transmission were excessive, and that he had transmitted gas at a cost very much less than the suggested figures. That bore out his (Mr. Martin's) point, that if the matter were closely gone into, a lower figure than the one he had suggested would be right. Mr. Brough had said that he (the author) had taken too pessimistic a view of what was going to happen in the future. He desired to point out that he had expressed no opinion at all of what was likely to happen in regard to the coal supplies of the country; he had simply said that if the rate of consumption went on increasing as it was at the present time, the supply would be exhausted in 108 years. It was also said that he had taken no credit for the economies which had been effected in blast furnace practice and in the substitution of electricity for steam on railways. He had simply taken the gross effect, and it would be seen that, in spite of those economies, the consumption of coal in 1904 showed a substantial advance over that of 1903. He had not omitted to take into consideration the amount of coal below a depth of 4,000 feet. Taking the Commissioners' estimate of this, and assuming that the present rate of increased consumption went on unchecked, that coal would last for another eighteen months after the coal above 4,000 feet had been used. He desired to repeat that he was not concerned with particular proposals, but simply said that something ought to be done in the interests of later generations to conserve the coal resources of the country.

A vote of thanks having been accorded to Mr. Martin for his interesting paper, the meeting terminated.

Mr. GEORGE BEILBY writes:—I much regret that it is not possible for me to be present to hear Mr. Martin's paper to-morrow night. I am deeply interested in the subject he proposes to discuss. It is just 21 years since I read a paper to the Society of Arts on "The Process of Fuel-Gas and Ammonia Making," which is now called "Mond." The industrial world was not ripe for it at that time, but to-day I hope these national developments will have a better chance.

MERCANTILE MARINE.

The merchant marine of the United Kingdom employed last year 257,937 hands. Of these 40,396 were foreigners, and 41,021 of the remainder were Lascars. No one would deny that if the marine was manned, as it used to be, entirely, or almost entirely, by natives of the United Kingdom, it would be very much better from the national point of view, than to have nearly a third of the men working British ships foreigners, and others who, though British subjects, are of an alien race. The difficulty is to arrest the ingress of the foreigner, and to replace him by the home seaman. In a recent article, *The Times* said that "if we average the earnings of these foreigners at £1 a week apiece, we get a sum of £2,000,000 a year of British money paid for the services of alien seamen." The estimate is probably within the mark. The monthly wages of able seamen and firemen on steamships range from 75s. to 90s., the lower figure being the exception, and although the rates paid on sailing ships are lower, they are not less than 60s. Taking, however, the sum paid in wages at £2,000,000, it would be better in British pockets, not to speak of the more important considerations connected with the national defence. But how is the change to be brought about?

The Foreign Seaman.—A favourite suggestion is the multiplication of institutions for training boys for a seafaring life, but the existing training ships find it difficult to place their boys afloat, and none of them are at present made full use of. Some of the County Councils are offering scholarships of £25 per annum to boys for the purpose of entering the Navy League Sea Training Home, at Liscard, but not many boys capable of winning an open scholarship of £25, would care to go to a home of the kind. And if these boys are got on board, the difficulty is to keep them there. Nor would the expansion of the apprentice system meet the want. There are plenty of captains and officers; the demand is for seamen and firemen. There are two main difficulties to be reckoned with, one the preference of the shipowner for the foreigner, or Lascar, the other the unwillingness of the British lad to undergo the privations of life before the mast. So far as the Lascars are concerned, they are British subjects, they are excellent seamen in the tropics, and individually they are much cheaper, though probably the shipowner does not save much by employing them, since if they get lower wages more of them are required to do the work. The 40,000 odd foreigners stand on a different footing. Sweden supplies more of them than any other country, then Germany, Norway, the United States, Russia, Denmark, in the order given. The majority of them are good sailors and decent fellows, but it may be questioned whether, as is often alleged, they are much more sober, amenable to discipline, and quicker satisfied than British sailors. Nor is there much differentiation in the way of wages.

Why Sea Life is Unpopular.—These facts suggest a growing disinclination on the part of British lads to go to sea, and the usual remedy is suggested—better wages. But as matters stand it cannot be said that wages are bad. The able seaman and the fireman shipping in steamers from northern ports gets 90s. a month, and, with very few exceptions, none have less than 75s. The able seaman in sailing vessels only gets 60s., but the total number of British seamen employed on sailing ships is less than 24,000, and even 60s. a month with board and lodging would not be unattractive other things being equal; but other things are not equal; and herein lies much of the explanation of why British lads will not go to sea, or going, will not remain at sea. It is the bad food and the bad accommodation that disgust them, and these must be improved if British lads of the class wanted are to take more readily to life in the mercantile marine and before the mast. All food and lodging must be better, and both might be made so without any great call, if any, upon the pockets of the shipowners, who, it must always be remembered, have very keen competition to reckon with, and restrictions to submit to which, however necessary, handicap them in competition with the foreigner, who is largely exempt from them.

Poor Food and Bad Cooks.—What is the fare? On certain days a pound and a half of salt beef, and on others a pound and a quarter of salt pork, to each man, with a certain amount of liquid, politely called tea or coffee. On some ships, in very cold weather, porridge is supplied for breakfast, but this is an addition that is not general. There is a little butter and some potatoes, and there is plenty of "biscuit," but the potatoes soon go rotten, and the biscuit is usually uninviting. Why cling to the biscuit diet? It has not even cheapness to recommend it. It is only an emergency ration in American ships, soft bread being issued in its place. Again, most American ships carry a large supply of potatoes stowed in properly constructed places, the object being to keep them good as long as possible. In this way they are kept sound for months, and while they last are served out daily to the crew. In English ships they are often dumped down in close proximity to the men's quarters and soon become rotten. Even with the food upon British ships as it is, it might be made much more palatable if the men shipped as cooks knew how to cook. Some certificate of competency should be required from cooks as from officers. As it is, very many of them, more especially in sailing ships, have no idea of elementary cooking, and food not very palatable at the best is made uneatable, and often nauseous by their ignorance and indifference to the wants of the crew as apart from the cabin. The Legislature has made compulsory certain space for sleeping accommodation, but a good deal might be done at small cost to make the sleeping and eating quarters more comfortable. These changes would cost very little to bring about, and could hardly fail to make decent British lads readier to go to sea.

TECHNICAL OVERTRAINING IN GERMANY.

It would appear that the German Empire is rapidly training a class of men for whom it has no employment at fair wages, and for whom the demand does not increase so fast as the supply, and the opinion in Germany seems to be gaining ground, that technical education has been carried far beyond the power to utilise it. The American Consul at Mannheim says that the question of erecting a school for the building trades in Mannheim being at present under discussion, a prominent constructing engineer has contributed an article to a leading newspaper of that city, in which he endeavours to show that technical education in Germany has gone beyond actual needs. He contrasts the number of those undergoing such training with the number in other professions, and concludes that the ranks of the technically trained are at present much overcrowded. He states that the number of those studying in the technical high schools in Germany in the winter of 1890-91 was 5,432, and in the winter of 1904-5, 15,866, or, in other words, there was an increase of about 200 per cent. On the other hand, the number studying theology in Prussia in the winter of 1887-88 was 2,713, and in the winter of 1903-4, 1,005, or a falling off of almost one-third. The number of medical students in Prussia in the summer of 1887 was 5,168, and in the winter of 1903-4, 3,020, a falling off of almost one-half. In the scientific technical branches of the departments of philosophy in the advanced schools which, as shown by experience, prepares a large percentage of technically trained students, the number of such students in the winter of 1901-2, was 1,100, and in the winter of 1903-4, 3,015. It thus appears that there is a rapid increase in the technically trained, that casts into the shade the well-known enormous increase in those trained in legal studies, which in 1899-90 amounted to 2,925, and in 1903-4, to 6,345. From the latter ranks also, it should not be overlooked, come many of those holding official positions in industrial undertakings. Similar conditions are to be noted in the middle and lower technical schools. Thus, in the 22 schools for the building trades belonging to, or receiving aid from, Prussia, the number of students in the winter of 1902-3 was 4,251, and in the winter of 1903-4, 5,077, an increase of 20 per cent. in a single year. For a period of ten years this increase would amount to 200 per cent. The number of special schools in the metal industries belonging to or supported by Prussia, in 1891 was 9, in the winter of 1903-4 it was 19, an increase of 110 per cent. The number of students in attendance in 1891 was 755, and in the winter of 1903-4 it was 3,010, an increase of 300 per cent. This number is equalled if not exceeded by those attending private technical schools. In Saxony, which may be looked upon as a kind of rearing-ground for middle grade technical students, the number of schools for machine construction in 1884 was two, with 524 students. In 1902 there were 6 schools, with 2,687 pupils, an increase of 200 per cent. in schools, and 410 per cent. in pupils. The number of schools for the building trades in 1885 was 5, with 469 pupils, and in 1902 it was 10 with 1,342 pupils, or an increase of 100 per cent. in schools, and 185 per cent. in pupils. It is apparent that the increased numbers in the technical ranks has gone far beyond the demand—200 per cent. against about 50 per cent. on the average. The consequence of this over-production in technical resources in a constantly diminishing rate of wages.

TRADE WITH MEXICO.

The economic development of Mexico is becoming so rapid, and its possibilities as a market for British goods are so important, that it may be useful to glance at the conditions of business there. It says much for the enterprise of European merchants that they have succeeded in retaining the share which they still enjoy of the Mexican trade. Geographical position gives the United States an immense advantage, but it has been lessened somewhat by the unwillingness of the American manufacturer and merchant to grant liberal terms of payment. European merchants draw at much longer date than American houses. Drafts of American merchants are generally drawn at sight thirty days, and occasionally at sixty or ninety days' date, whereas it is the custom for European bills to be drawn anywhere from three to six months' sight, or even longer, the longest terms being given by the French wine houses. Often American merchants instruct their bankers to obtain payment or acceptance of drafts before the delivery of the accompanying bills of lading, which causes friction, the customer naturally objecting to payment or acceptance before he has had an opportunity of examining the goods. European sellers again too are more willing to compromise where matters are in dispute than Americans who do not like to give way. Owing to tardy postal communications, collections in some parts of Mexico take a long time, as, for example, in the State of Sonora. At Mérida again, the capital of the State of Yucatan, merchants do not always pay their bills on their due date, but they voluntarily pay interest for the over-due days, a week or even a fortnight.

Drafts are not subject to days of grace. When not accepted on presentation, or paid on due date, they must be protected next day for non-acceptance, or non-payment, and if the protest be delayed beyond that time it has no legal force. Drafts falling due on Sundays and holidays are payable the previous day, and the Notary Public, or if there is not one in the place the political authority, making a protest must retain the draft until sunset of the same day in order to give the drawee an opportunity to pay it, together with expenses incurred. The holder of a draft cannot refuse to accept a partial payment, but he may have protest made for the remainder.

The stamps drafts must bear one as follows:—Up to 100 dols., 2 cents.; beyond that amount, and up to 500 dols., 5 cents.; 1 cent. for every additional 100 dols. or fraction thereof; exceeding 100,000 dols., 10 dols. Drafts in foreign money must be converted into Mexican currency for the purpose of ascertaining the amount of stamps required. Between a draft and a cheque there is, in Mexican law, a great difference. Cheques are payable only to the person named, or to bearer, and are not endorsable. The holder of a cheque must present it within eight days of its date if drawn in the same town, an entire day being added for every 100 kilometres which separate the places of issue and of payment. Non-compliance with this condition deprives the holder of all legal rights against the drawer in case of the bankruptcy of the drawee. A cheque up to 100 dols. requires stamps for 2 cents., beyond that amount 5 cents. The legal rate of interest when the rate is not mentioned is 6 per cent. per annum. No maximum rate of interest is fixed by law.

THE INDUSTRIAL GROWTH OF LATAKIA.

Latakia, with a population of about 25,000, is the centre of a highly fertile and productive agricultural district, which has lately experienced considerable development. Much good land is still however lying idle. Tobacco, olive oil, cotton, licorice root, wood, skins, sponges, honey, soap, and cereals (wheat, barley and millet) are the main exports. Olive oil, licorice root, and tobacco are beginning to be shipped to the United States, and according to American reports, this trade is likely to increase. Olive oil is figuring among Syrian exports to the United States as an item of advancing importance. Its production has increased of late years, and promises to become one of the chief industries of Syria. The olive tree requires but little care, and lives to a great age. In Syria the fruit is knocked off with sticks, and the injury thus caused to the branches probably accounts for the short yield every second year. The plantations are being extended principally in the littoral plains between Jaffa and Latakia, and the finer sorts of oil produced are said to be equal in quality to Italian oil, and to rival the best oils in the markets of Europe and America. Refined olive oil is exported from an American factory at Haifa, while cruder oils in bulk are shipped from Beirut and Latakia to be purified and clarified abroad. Hydraulic oil presses are now being introduced in Syria. Latakia tobacco (*abou Riha*) is an article of commerce well known in Europe and America. It is black in colour, owing to its fumigation by the Nusairieh mountaineers in the smoke of a tree called "elezzer," "or ezr," which imparts to it a peculiar aromatic flavour. This fumigation lasts for from seven to nine months, but only produces the desired effect during the winter and spring, although the tobacco is still fresh and green in summer, when it is hung in the rafters for smoking purposes. The "ezr" grows wild, seldom attaining the size of the oak, and gives out its aromatic odour when burned in the green state. It is a native of the Nusiarieh Mountains, and not found elsewhere, so it is claimed. An average crop of Latakia tobacco, so far as it is available for export, is worth about £70,000.

BOLIVIAN RUBBER.

Rubber is not produced in Chile, but in all the country watered by the River Amazon, comprising large portions of Bolivia, the ports of entry for which are in Chile, the industry is attracting the attention of foreign capitalists. The more elevated parts of the Amazon region produce the kind of rubber known as "caucho," while the lowlands, flooded by the river, produce the "jebe." Caucho and jebe are very similar, the only difference consisting in the greater elasticity of the latter. Hence jebe is made to serve more delicate purposes, and commands a higher price in the market, the difference being usually about 25 per cent. in value. The two kinds of material are extracted in different ways. In the case of jebe, according to the United States Consul at Valparaiso, incisions are made spirally along the whole length of the tree, whereas to obtain the caucho, the tree is cut down and the sap or milk is caught in vessels specially adapted for the purpose. The caucho tree cannot stand incisions in its bark, but in twenty years time after being felled, a new tree grows up and is ready for treatment. The caucho tree is estimated to yield about sixty-five pounds, worth from about three shillings to four shillings per pound on the spot, and about two shillings more in the market. The jebe tree will yield about twenty-five pounds a year for an indefinite time. Small sections of the rubber-producing forests adjacent to the head waters of the Amazon have been depleted, but the rapid natural growth of the tree will, it is said, soon rehabilitate these districts, rendering them again productive. The development of the rubber industry in Bolivia is of special interest to Chile and to other countries having commercial relations with west coast South American countries, for the reason that all Bolivian products, exported from the Pacific Coast, must reach the markets through Chilean ports. The building of railways through Northern Chile into Bolivia, under the treaty between the two countries of 1905, will encourage the development of the natural resources of Bolivia by affording transportation facilities for marketing the products. The vast tracts of rubber-producing forest in the upper Amazon country, which produced last year over 50,000 tons of rubber, valued at over £20,000,000, and only a small proportion of which has been exploited, offer, in the opinion of the American Consul, an attractive field for the investment of capital.

HOME INDUSTRIES.

Official Trade Reports.—In a recent debate upon the Consular Service Sir Edward Grey pointed out that the Annual Reports of British consular officials abroad are much more up to date than they used to be; that they are not only sent on by the consul with less delay, but are more quickly issued by the Foreign Office. That is admitted, and the change has made these reports, or some of them, of real value to the trading community, although whilst they are for the most part published only annually, they will remain much less valuable, for other than purposes of reference, than they might be. But, whilst there has been much improvement in the date of publication of consular reports, the improvement is less marked, and, indeed, is not always at all visible, in the colonial reports issued by the Colonial Office. For example, last week there was issued the Ceylon Report for 1904. It was sent on from Colombo, by the Governor, Sir Henry Blake, on January 17, so that there has been no unreasonable delay on the part of the Colonial Office; but surely the report on the trade of Ceylon for 1904 should have been in the hands of the Governor before 1906? It is true that an explanatory note says that the report has been delayed "owing to the revision of the accounts of the colony." The delay that so often occurs in the presentation of colonial reports is the more unfortunate because, belated as they are, they are the only documents of an official kind available to give traders indications as to the trend of trade in British colonies, and the best means of extending it. In foreign countries the British consul plays his part. The self-governing colonies have agencies in London always ready to do what they can in the way of information and assistance to traders, but almost the only official information to be got about the Crown colony and its trade position is to be found in the Annual Reports, and such information is of little or no practical value when delayed, as in the present case of Ceylon, for a year after it ought to be in the hands of the public.

Cotton Supplies and Labour.—The reports of the growth of the area under cotton cultivation in the Crown Colonies are encouraging. In St. Vincent, for example, though the acreage under cotton in the island is somewhat less than that for last year the quality of the cotton is unsurpassed, and samples of the present crop have been valued at the highest rates in the market. But it is to be feared that the labour problem will be a serious obstacle to any very large extension of cotton cultivation in these West Indian islands. This has always been one of the main difficulties in the way of cotton cultivation in the West Indies, and the construction of the Panama Canal will soon be draining the islands, or some of them, of the best of their labour. Big inducements are being held out in the shape of high wages to Jamaican and other labourers, and although the Windward Islands, being farther away, are not likely to be so greatly affected the Panama offers must affect the labour market generally, and may prove a serious obstacle to the development of cotton cultivation. It must not be forgotten that indentured Indian labour is only available in British Guiana and Trinidad to any considerable extent, and in these colonies it is confined to the sugar plantations. Barbadoes, with its 1,400 people to the square mile, is more fortunate. There native labour is abundant, cheap, and good, and the native does not care to go as far afield as Panama. Soil and climate, too, are excellent for cotton growing, and although the planters are ultra conservative in their agricultural beliefs, some of them have begun cotton cultivation, and last year's results were very encouraging, a net profit of £10 an acre being made on several estates, which is a good deal more than can be made from sugar in these days, even with the help of the Convention. How much remains to be done before the British Empire—apart from India—supplies any considerable portion of home requirements may be gathered from the statistics of supply for the first week of the present month. The number of bales of cotton imported into the United Kingdom during the week ended March 1 was 83,311, and of these 190 came from the British West Indies, and 90 from the British West African Colonies.

The American Cotton Crop, 1905-6.—In these notes in the *Journal* of February 16 reference was made to what was likely to be the total American cotton crop for the year 1905-6. It was pointed out that, taking the quantity ginned to date, and assuming that the average under-estimate of the American Government in the past six years was reached for 1905-6, the total yield would be 10,767,000 bales, and the conclusion was arrived at that "it is pretty safe to say that the commercial crop of 1905-6 will exceed 10,500,000 bales." The United States Census Bureau has now issued its final report on the amount of cotton ginned from the growth of 1905, and, counting round bales as half bales, and, including linters, it comes to 10,697,000 bales. In this connection may be mentioned the sailing for the United States of an important commission organised by a number of Lancashire spinners and manufacturers. The object of the commission is to make inquiry on the spot into the present unsatisfactory methods of baling, marketing, handling, and transporting cotton, as well as to ascertain the actual cost of growing cotton on a commercial basis in the Southern States. On arrival the commission was met by several New England representatives of the American textile industry, some of whom will accompany the party in their visit to the Southern States. The British ambassador at Washington, and the British consuls in the Southern States, have been instructed by Sir Edward Grey to afford the commission all possible assistance.

Secret Commissions.—There is ground for the belief that the present session of Parliament will see

the Prevention of Corruption Bill pass into law. It has already been read a third time in the House of Lords, where the Lord Chancellor intimated that the Government will star the Bill on the order paper of the House of Commons, and treat it as their own Bill. It is a much shorter Bill than any of its numerous predecessors, and is not open to some of the serious objections taken to them. For example, Lord Russell's Bill of 1899 created a statutory crime, and threw upon the accused the onus of proving his innocence; whilst no provision was made for the protection of legitimate commissions. A year or two later Lord Halsbury took up the Bill, but as it originally stood it, too, attempted to place the onus of disproof upon the accused; and failed to protect sub-agency. The present Bill meets these objections, and provides that if any agent corruptly accepts or attempts to obtain, or agrees to accept or attempts to obtain for himself, or for any other person, any gift or consideration as an inducement or reward for doing, or for bearing to do any act in relation to his principal's affairs or business, or for showing or forbearing to show favour or disfavour to any person in relation to his principal's affairs or business, he shall be guilty of a misdemeanour, and shall be liable on conviction on indictment to imprisonment, with or without hard labour, for a term not exceeding two years, or to a fine not exceeding £500, or to both such imprisonment and such fine, or on summary conviction to imprisonment, with or without hard labour, for a term not exceeding four months, or to a fine not exceeding £50, or to both such imprisonment and such fine. The same penalties apply to any person who agrees to give, or offers any gift or consideration with a corrupt intention. It is to be noted that the Bill proposes to make any person serving under the Crown an agent within the meaning of the Act. Section 2 provides that a prosecution for an offence under the Act shall not be instituted without the consent of the Attorney-General or Solicitor-General. The difficulty will be to obtain evidence sufficient to convict, more especially as the ordinary juryman will not readily be brought to view the acceptance of a secret commission as an offence deserving imprisonment, the practice has penetrated too deeply unhappily into business methods. But it can hardly be doubted that the Act would be a deterrent.

The Yield of Rubber.—Reference was made in these notes last week to Dr. Schlich's letter in which he stated that "to yield permanently a ton of rubber per year requires not less than ten acres of plantation," and it was remarked, as must be obvious enough, that yield depends on climate, soil, number of trees per acre, management, and tapping. Mr. Nisbet, formerly Conservator of Forests in Burma, now contests the accuracy of Dr. Schlich's estimate, says indeed it is very wide of the mark, and that he does not think Dr. Schlich "can possibly have seen a typical *Hevea* rubber plantation worked on any commercial scale." Mr. Nisbet is of opinion that, giving an ample margin for risk, an acre will give not 2 cwt. per acre, as Dr. Schlich says, but at least 4 cwt., and his calculation is as follows:—"Assuming the trees to stand about 18 feet apart when in full bearing (*i.e.*, each tree having a growing space of $18 \times 18 = 324$ square feet), there will be 135 trees per acre. Now experiments in Ceylon and elsewhere have shown that mature trees can yield upwards of 5 lbs. of dry rubber per annum, and on a basis of 5 lbs. this will give $135 \times 5 = 675$ lbs., or 6 cwt. of marketable rubber per acre. Diminish this by one full third, to eliminate risk of over-estimating—$33\frac{1}{3}$ per cent. seems a very ample margin—and the yield will still be 4 cwt. per annum." The point is a very important one for those interested in the rubber trade and rubber-producing companies, but it is a most difficult matter to arrive at any really satisfactory estimate of the amount of the yield to be expected from cultivated Para trees. As to Mr. Nisbet's estimate of 4 cwt. per acre, a good deal depends upon what he means when he speaks of "mature" trees. Would he call a tree less than twelve years old "mature?" Those interested in the subject may be referred to "The Cultivation and Preparation of Para Rubber," pp. 71-76. The author, Mr. Johnson, speaks with authority on the subject; and after giving the result of various experiments and records in Ceylon, the Malay Peninsula, and the Gold Coast, his conclusion is that "providing the site for the plantation has been carefully selected, and cultural details attended to, about 50 per cent. of the trees should be ready for tapping at the end of the sixth year, but whether tapping should take place must of course depend upon the price of labour, as only an average of $\frac{1}{2}$ lb. of dry rubber can be expected from each tree tapped at that age. The following year practically every tree on the plantation should be ready for tapping, and the average yield would be about $\frac{3}{4}$ lb., and the following year 1 lb. These figures are of course approximate, and much below the returns obtained on many estates both in Ceylon and in the Malay Peninsula."

The Courrières Colliery Disaster.—In connection with the appalling catastrophe at the Courrières Collieries, the opinion seems to be general in England that it was due to most culpable indifference on the part of the management to the conditions under which the workings are carried on. There would seem to be no ground whatever for this opinion. Professor Redmayne shows that the average death-rate underground at the collieries has been steadily falling during the last thirty years, and that taking the ten years 1890-1899, it was considerably lower than at mines under the Coal Mines Act in Great Britain. Moreover, the results obtained from its system of systematic timbering have been so good that the Home Office sent over four Inspectors in 1901 to report upon it, and their report led to the introduction of the special rules as to systematic timbering now in force in most coal-mining districts in this

country. No explosion of firedamp seems to have ever been recorded at the Courrières mines since the inception of the company in 1849, nor has gas been often detected in the workings, where naked lights are largely, if not exclusively used. The discipline is said to be stricter than at many British collieries, and this although the seams do not give off much gas. The cause of the disaster remains to be explained. Again it has been said that the apparatus employed by the Westphalian Reserve Corps is of German origin, and that it is practically unknown outside Germany, but Messrs. Siebe, Gorman and Co. write to say that it was the invention of an Englishman, Mr. H. A. Fleuss, and that they have been manufacturing the apparatus for thirty years. As far back as 1880 it was used at the Seaham Colliery after the disaster which occurred there in that year, and a few years later it was instrumental in saving ten lives at the Killingworth Colliery. Again it was used with excellent results at the flooded Severn Tunnel, some years ago. The Fleuss principle has been adopted in all countries, including Germany.

GENERAL NOTES.

House of Mrs. Siddons.—In 1876 the Society of Arts affixed one of its commemorative tablets on the house 27, Upper Baker-street, where Mrs. Siddons, the actress, died in 1831. A short time ago this house was demolished by the Metropolitan Railway Company, but at the instance of the London County Council, the tablet was re-erected with a supplementary tablet explaining that the premises had been rebuilt and the original tablet refixed.

Industrial Naples.—In his report on the trade of South Italy, in 1905 (No. 3530, Annual Series), Mr. Consul-General Neville-Rolfe alludes to the industrial development of Naples, now beginning to be very apparent. A large cotton-mill, an important factory for beet-sugar, and a vast rope-walk are being promoted by local capitalists. The financial condition of the municipality is such as it has never been before, and it is said that the accounts for the year will close with a surplus. The students from the universities and the Government schools are no longer content to seek poorly-paid Government employment, or to enter into the ranks of the over-crowded professions, with their inadequate fees, but are seeking technical instruction, so that they may join in the new movement, and make an adequate future for themselves. There are numerous industries which, if not entirely lacking in Naples, are capable of indefinite development. The Consul-General says that many inquiries have come in from British firms, "some of which will, no doubt, bear fruit."

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

April 4—"Ramie and its Possibilities." By Mrs. Ernest Hart. Illustrated by Samples manufactured by A. M. Hart, Ltd. Sir John Alexander Cockburn, K.C.M.G., will preside.

April 25.—"The Production and Collection of the Picture Postcard." By Frederic T. Corkett (of the firm of Messrs. Raphael Tuck and Co.).

May 2.—"Submarine Signalling." By J. B. Millet.

May 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By Professor Thomas Oliver, M.D., LL.D.

May 16.—"The Development of Watermarking in Hand-made and Machine-made Papers." By Clayton Beadle.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

April 26.—Colonel Sir Arthur Henry McMahon, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

May 24.—Major Percy Molesworth Sykes, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

May 1.—"Social Conditions in Australia." By the Hon. J. G. Jenkins, Agent-General for South Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock:—

May 8.—"Damascening and the Inlaying and Ornamenting of Metallic Surfaces." By Sherard Cowper-Coles.

May 29.—"Glass Cutting." By Harry Powell.

*** This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

Prof. Vivian B. Lewes, "Fire: Fire Risks and Fire Extinction." Four Lectures.

Lecture IV.—April 2.—Fire Prevention—The Fallacies Existing as to Fireproof Material—Stone and Iron *versus* Wood—Heat Conductivity—Fireproofing Wood and Textile Fabrics—Fire Extinction—Sprinklers—Chemical Fire Extincteurs—Alarms.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Vivian B. Lewes, "Fire, Fire Risks, and Fire Extinction." (Lecture IV.)

Farmers' Club, 5, Whitehall-court, S.W., 4 p.m. Mr. D. J. Lloyd, "The Relation of the Medical Profession to the Dairy Industry."

Royal Institution, Albemarle-street, W., 5 p.m. (General Monthly Meeting.)

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Frank Latham, "Harbour Exigency Works."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. E. J. Watkins, "The Ropiness in Flour and Bread, and its detection and prevention." 2. Mr. V. H. Veley, "The Röse-Herzfeld and Sulphuric Acid methods for the determination of the Higher Alcohols."—A Criticism.

British Architects, 9, Conduit-street, W., 8 p.m. Messrs. W. Aumonier and A. W. Martyn, "Wood Carving."

TUESDAY, APRIL 3...Royal Institution, Albemarle-street, W., 5 p.m. (Tyndale Lectures.) Dr. J. E. Marr, "The Influence of Geology on Scenery." (Lecture III.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Alpine Club, 23, Savile-row, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Cathcart W. Methven, "The Harbours of South Africa." 2. Dr. T. E. Stanton and Mr. L. Bairstow, "The Resistance of Iron and Steel to Reversals of Direct Stress."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Practical Demonstrations by the Autotype Company of their Trichrome Tissues."

Colonial, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. P. J. Hannon, "The New Agricultural Movement in Cape Colony."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mrs. Scott, "The Growth of Plants and the Opening of Flowers."

WEDNESDAY, APRIL 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mrs. Ernest Hart, "Ramie and its Possibilities."

Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 12 noon. 1. Address by the Chairman, the Earl of Glasgow, 2. Admiral C. C. P. Fitzgerald, "The New Scouts." 3. Sir Edward J. Reed, "Vessels constructed for Service in our Colonies and Protectorates."

Geological, Burlington-house, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. Montagu Sharpe, (*a*) "The extensive line of British Stakes protecting the ford across the Thames at Brentford"; (*b*) "Did Caesar cross here"; and (*c*) "Were the Conway Stakes in existence B.C." ?

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, APRIL 5...Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 12 noon. 1. Mr. R. E. Froude, "Yacht Racing Measurement Rules and the International Conference." 2. Mr. Linton Hope, "The Speed of Motor Boats and their Rating for Racing Purposes." 3. Mr. James A. Smith, "The Design and Construction of High Speed Motor Boats." 7.30 p.m. 1. Mr. J. E. Thornycroft, "Gas Engines for Ship Propulsion." 2. Prof. R. L. Weighton, "The Efficiency of Surface Condensers."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. Spencer Moore, "A Second Contribution to the Flora of Africa—Rubiaceæ and Compositæ," Part II. 2. Mr. E. J. Schwartz, "The Anatomy of the Stem and Leaf of *Nuytsia floribunda*, R.Br." 3. Mr. B. Hayata, "*Taiwanites*, a New Genus of Coniferæ from the Island of Formosa."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. B. Hopkinson, "Internal Combustion Engines." (Lecture III.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. G. D'A. Meynell, "Steam Turbines."

Electrical Engineers, 25, Victoria-street, S.W., 8 p.m. 1. Mr. C. F. Sparks, "Electrical Equipment of the Powell-Duffryn Company." 2. Discussion on Mr. W. C. Mountain's paper, "Electric Winding considered Practically Commercially."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Chemical, Burlington-house, W., 8½ p.m. 1. Dr. W. H. Perkin, senior, "An Improved Apparatus for Measuring Magnetic Rotations and obtaining a powerful Sodium Light." 2. Mr. G. T. Moody, "The Rusting of Iron." 3. Messrs. A. D. Hall, N. H. J. Miller, and N. Harmer, "The Determination of Carbon in Soils." 4. Messrs. J. Walker and J. K. Wood, "The Electrolysis of the Salts of $\beta\beta$-dimethylglutaric Acid." 5. Mr. J. K. Wood, "Bromo and Hydroxy Derivatives of $\beta\beta\beta^1\beta^1$ Tetramethylsuberic Acid." 6. Mr. G. Stallard, "Some New Orthoxylene Derivatives." 7. Mr. J. Moir, "A New Solvent for Gold: Preliminary Note." 8. Messrs. S. E. Sheppard and C. E. K. Mees, "The Molecular Condition in Solution of Ferrous Oxalate: a Correction."

United Service Institution, Whitehall, S.W., 3 p.m. Colonel J. N. Legard, "Proposals for the Future Raising, Organisation, and Training of Artillery Militia."

FRIDAY, APRIL 6...Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 12 noon. 1. Mr. J. Foster King, "Notes on the Freeboard Rules." 2. Mr. J. L. Twaddell, "The Overhead Wire Cableway applied to Shipbuilding." 3. Mr. Alexander Murray, "The Introduction of Cranes in Shipyards." 7½ p.m. 1. Mr. Herbert Rowell, "Oil Tight Work in Ships of Light Construction." 2. Mr. J. R. Barnett, "Steam Yachts: Some Comparisons."

Royal Institution, Albemarle-street, W., 9 p.m. Mr. W. B. Hardy, "The Physical Basis of Life."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. B. F. Beverley, "Variations in Direction of the Wind, and an Instrument for Determining them Graphically."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street. E.C., 8 p.m. Paper on "Internal Architecture of Theatres."

Architectural Association, 9 Conduit-street, W., 7½ p.m. Mr. E. Greenop, "Valuations, Compensations, and Light and Air."

Geologists' Association, University College, W.C., 8 p.m. Mr. S. Hazzledine Warren, "The Pressure-chipping of Flint, and the Question of Eolithic Man."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, APRIL 7...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "The Corpuscular Theory of Matter." (Lecture VI.)

Journal of the Society of Arts.

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FRIDAY, APRIL 6, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CANTOR LECTURES.

On Monday evening, 2nd inst., Prof. VIVIAN B. LEWES delivered the fourth and last lecture of his course on "Fire, Fire Risks, and Fire Extinction."

Captain JAMES DE COURCY HAMILTON, R.N. (Chairman) proposed a vote of thanks to the lecturer, which was seconded by Major FOX, and carried unanimously.

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 4th, 1906; THE HON. SIR JOHN A. COCKBURN, K.C.M.G., in the chair.

The following candidates were proposed for election as members of the Society:—

Elliott, W. R., Forestry Officer, Lokoja, Northern Nigeria, West Africa.
Parratt, John William, Craiglands, Ilkley, Yorkshire.
Tierney, J. Wilbur, Ashtree, Beulah-hill, S.E.

The following candidates were balloted for and duly elected members of the Society:—

Anderson, Charles Goldsborough, Oratory Studios, 16, Fulham-road, S.W.
Blake, Henry D., The Limmer Asphalte Paving Company, Ltd., 2 Moorgate-street, E.C.
Karandikar, Raghunath Pandurang, High Court Vakil, Satara, Bombay, India.
Mahtab, Bijoy Chand, Maharaja Dhiraj of Burdwan, The Palace, Burdwan, Bengal, India.
Mason, Alfred W., 21, Queen-square, W.C.
Meads, Charles James, Bel Air, Dartmouth, Devonshire.
Webb, Alfred H., Los Salidos, Linares, Prov. de Jaen, Spain.
Whitcombe, Algernon Henry, 11-12, Clarence-street, Cheltenham.
Wood, Hon. Josiah, Sackville, New Brunswick, Canada.

The CHAIRMAN, in introducing the reader of the paper, said it was one of the functions of the Society of Arts to inquire into and foster every new movement in industries, and among industries that of the manufacture of textile fabrics ranked as not the least important. Mrs. Hart was one of the great captains of industry in textile fabrics, while as a writer, an artist, and a designer, she also filled many channels of activity. He had had the opportunity of examining some of the fabric manufactured by Mrs. Hart from ramie, some of which was as light as gossamer and some as heavy as canvas, but it was always strong and durable whatever the variety of the texture, and he believed Mrs. Hart had solved many of the difficulties which surrounded its manufacture.

The paper read was—

RAMIE AND ITS POSSIBILITIES.

By MRS. ERNEST HART.

"Ramie!" exclaimed a gentleman in my presence on being asked his opinion, "Ramie spells ruin to anybody who has anything to do with it." The head of a Government Department is reported to have said, "anybody who has anything to do with ramie is either insane or will go mad." Another Government official sent me word that as it was impracticable to make dress materials of ramie, it would be well for me to confine myself to the making of umbrella covers. On sending a traveller to one of the great merchant houses of the north to show our fabrics, he was met with the remark, "Ramie! don't talk to us about ramie, we have lost quite enough money on it, we don't ever want to hear the word again: besides we know it can't be woven." "But here are the

woven fabrics, will you not let me show them," persisted the traveller. "No you needn't," was the reply, "we *know* ramie can't be woven." And the traveller was not allowed to exhibit our fabrics to this doubting Thomas of commerce. It was with such douches of cold water that it was attempted to quench the ardour of my enthusiasm and to weaken my determination to overcome the well-known difficulties of ramie weaving.

It is not, however, to be wondered at that in this country a new ramie enterprise was looked upon as doomed to failure, doomed to follow in the melancholy procession of companies floated on the wings of high hopes and big promises, to sink into oblivion, with the record of millions of money lost and squandered, lost in unsuccessful attempts to put ramie fabrics on the market.

Fifteen, twenty years ago, numerous companies were formed with large capitals, pledged to make ramie one of the great staple textiles of the world. To mention only a few of these companies: The Rhea Fibre Treatment Company, the Castleton Mills Company, the Castle Fields Company, the Anglo-Chinese Company, the Ramie Spinning Syndicate, the mills of all of which are now silent, and in most cases dismantled and turned to other uses.

The causes of this remarkable and almost universal failure in Great Britain, are stated to have been want of raw material, imperfect methods of degumming which rotted the fibre, the difficulties of manipulating the fibre in machines not specially constructed to deal with it, and the intractable behaviour of ramie yarns in the loom. It should also be added that in many cases the companies were promoted in a purely speculative spirit, and the management was in the hands of those who did not aim by patient investigation at overcoming the difficulties of ramie manipulation in the factory, but were unfortunately too much interested in the more exciting game of manipulating shares on the Stock Exchange.

Promises of immense profits were made in the prospectuses, charming samples of fabrics were produced, quotations of shares rose by leaps and bounds to high figures, but when orders were placed the samples could not be reproduced in pieces, shares fell as rapidly as they had risen, and a spirit of despair settled down on the ramie world of England and her dependencies. Factories were closed, companies liquidated, plantations in India and elsewhere were rooted up, and the whole subject was quietly disposed of by manufacturers, in the statement "We have tried ramie and nothing can be done with it." The loss of money, however, rankled, and ramie became the *bête noire*, the skeleton in the cupboard, of British commerce.

But while British manufacturers simply gave up ramie, or a few small spinning factories were carried on on an unprofitable basis for a few years longer, steady progress was being made on the Continent in the effort to overcome, by scientific methods, the difficulties of degumming without injury to the fibre, and to ascertain the correct principles and processes of spinning. A new use was discovered for the fibre, which gave a great impetus to ramie spinning: this was the use of ramie in the manufacture of gas mantles. What was required was an absorbent netting which would absorb the mineral salts and be afterwards burnt away, leaving the least amount of a perfectly white ash behind. Egyptian cotton had been used for this purpose, but gas mantle manufacturers found, in a webbing made of ramie yarns, a material which suited their requirements exactly. This discovery led to a great development of the existing ramie spinning mills of Germany and France, and to the perfecting of their processes and machinery.

The German mills then took up the manufacture of ramie stockingette for underwear, of hosiery, and of knitted goods in which the yarn used is mixed more or less with wool. In France and in Switzerland the weaving of coarse linens for restaurants has been carried on in a moderate degree, though the representative of Messieurs Favier in Paris told me that owing to the extraordinary durability of these linens, made at one time by themselves, they were boycotted by the buyers of the great French retail houses, so that they consequently gave up weaving them, and confined themselves to spinning. The making of plushes from ramie has been also accomplished at Chemnitz; in Japan the blending of ramie with silk has been successfully carried out; in Holland fishing nets are manufactured of ramie yarns, and both in Sweden and in the United States stockingette for underwear is made on frames, of imported yarns: in Germany and France ramie yarns are used in a limited degree as weft on woollen or cotton yarns to give brilliancy to fabrics; and sail cloth for yachts has also been made on a small scale.

I think I have mentioned what had been done in the use of ramie in various textiles till I started with the avowed intention of

manufacturing pure ramie fabrics warp and weft; the known difficulty being to weave with a pure ramie warp, for though the fibre is of surprising strength, the strongest yarn breaks at the knot with the greatest facility, and it does not stand well the shock of the loom at the opening of the shed.

As I am frequently asked what induced me to take up the question of ramie weaving, and as my audience will expect an answer to this enquiry, I will give a brief account of my own work in weaving ramie.

As is well known, I was engaged for many years (and am still) in encouraging Irish village industries by founding various industries and training workers. The weaving of hand-made linens of beautiful colours in cottages was one of these. Looking round always for new ideas, I noticed in the Colonial Exhibition of 1885 a case of ramie in which the fibre was shown in the raw state, degummed, as sliver, and as dyed yarns. I sought out the man in charge of this exhibit, and asked if yarns could be supplied of this brilliant, silky fibre, but I was told that the exhibit was only of scientific interest, and that to make weaving yarns was not yet practicable.

A few years later I read a notice in the papers that the difficulties of ramie spinning had been overcome. I immediately wrote to the factory mentioned, and obtained white yarns, which I used as weft on linen warps, and one of the first things woven on our looms was a piece of cloth for a waistcoat, which has figured in many letters to the press, and which I know is still in wear. On the closing down of this factory we bought up stocks of ramie yarn, and continued weaving it in conjunction with unbleached linen and exporting the cloth to India, where it obtained a high reputation for its wearing qualities, and its stubborn resistance to dhobie washing.

Stimulated by the assertion that it could not be done, I determined in the summer of 1902 to attempt the weaving of pure ramie fabrics, warp and weft. I put up a small Swedish hand-loom in a shed in my garden at Totteridge, and engaged an expert hand-loom weaver—a Finn girl—to come and work as a sample weaver. On this simple loom we got out our first samples, and boldly submitted them to one of the first dress goods houses in London. They were approved, and I was encouraged to go on. A witch loom and a Domestic loom, with power-loom action worked by the feet, were added to the plant, and while I designed or copied patterns and pegged them on the witch, the weaver wove them, and together we proved the point that ramie could be woven in piece lengths, warp and weft.

The looms were then transferred to a weaving shed in a village in Yorkshire, the number of hand looms was brought up to sixteen, and they were placed under the direction of a manager, who, added to the most intimate knowledge of looms and weaving, a rare sense of colour. Orders began to come in from good houses, but they soon necessitated the use of broad-width power looms. Another small mill was rented and fitted with ten power-looms, gas engine and winding, beaming, and twisting machinery. Then began the true difficulties of the undertaking, for we had to meet and overcome the difficulties of weaving, in this inelastic fibre, fine dress fabrics on broad-power looms, difficulties which in England had vanquished those who had attempted the same before. One by one, however, they were steadily overcome, and there is now scarcely anything that we cannot weave in pure ramie, warp and weft, from the lightest gossamer to cloth that has a breaking of nearly 500 lbs. to the inch, from heavy tapestries to light dress goods, from fancy upholstery repps to muslins. All the fabrics here shown, are of pure ramie, warp and weft, and were woven at our mills under my personal direction.

Again and again we were fairly beaten, the workers would not stay to be so worried, the looms broke down under the strain put on them, the winding of the yarns drove everybody silly; but we always began again, determined to succeed, and would not accept failure.

Not the least of our difficulties were created by the yarn spinners. To get weaving yarns spun for me I applied to the spinners of gas mantle yarns, or of ramie thread, to worsted spinners, flax spinners, and jute spinners. Numerous and costly experiments were made in England, but none of the yarns were satisfactory, as the spinners had not the proper plant on which to spin ramie yarns, and were unwilling to put up the same, and they soon tired of making experiments to reach the perfection of manufacture I required. I then went to France; but the yarns, though beautiful in appearance, were too brittle. I then went to Germany, and at last found spinners willing to take any amount of trouble to do what I required. "We do not care what trouble Mrs. Hart gives" they wrote, "so long as we please her in the end." In England the spirit of the

replies to my requests, used to be in those early days, "Well—it is the best we can do, and if you do not like it you must lump it." It is the scientific spirit of pains-taking industry which gives Germany her increasing commerce, in spite of hampering tariffs; it is the conservative spirit of anti-scientific ignorance which loses Great Britain her commercial supremacy, in spite of the benefits of free trade. In nothing is this more visible than in the ramie industry; once almost solely in the hands of Great Britain, whose colonies could supply her with indefinite supplies of raw material, and lost through over-reaching speculation and lack of science, this industry passed to Germany, who applied to the elucidation of its secrets and the perfection of its methods, the science and patience lacking in this country.

To return to the story of our own work. Having now overcome the technical difficulties, my next care was to place the goods on the market, but though orders were placed by the best dress and upholstery houses our plant, was then too small, our possible output too limited, and our capital too narrow to do ourselves justice. I had borne all the expense of the great experiment, and not being a capitalist, this was only done at the cost of great personal sacrifice. I was assured by business friends, and by willing promoters, that it would be easy to find capital to enable me to increase the plant, take advantage of the trade offered, and create a sound industrial enterprise; but English capital was shy; it had been hit too heavily in the past by ramie to believe in the genuineness of a new ramie industrial undertaking: incredulity as to ultimate success was expressed on all sides in such terms as "it is absurd to think that Mrs. Hart can succeed where Lister failed." "Oh, yes, Mrs. Hart will make samples as they all did, but she will never make pieces," and so on, and the enormous sums of money lost by the speaker or by his friends, were instanced as proofs of the disastrous character of ramie undertakings.

But help came from another, a more confident and bolder country than old England, namely, from America, and it was with American capital that "A. M. Hart, Limited," was formed, and the enterprise was lifted from the experimental stage to that of a sound commercial industry. English capitalists have since joined us, but at a critical time it was due to the action and initiative of my American co-director that the enterprise was firmly established on a commercial basis. From that date we have gone forward with no uncertain steps; we have rented a large mill, have put up a considerable amount of machinery, and are engaged in executing orders and Government contracts, which are only an earnest of what we expect and which we are prepared to carry out.

I should mention that considerable prominence was recently given to our dress fabrics by the kindly interest taken by the Princess of Wales in the same. The Princess wrote to me saying she was very much interested in ramie, and she ordered a white washing material to be woven for costumes to be included in her outfit for India. This ramie costume excited great attention in the Press when the outfit was on view, and the Princess not only wrote to say she was charmed with "the delightful material" we had made for her, but gave me permission to publish this expression of her opinion about our ramie materials in "The House Beautiful." On a previous occasion the Princess was kindly interested in my making the winter hangings for Marlborough House of ramie, but the time given in which to execute the order was unfortunately too short for us to carry it out. The Princess of Wales has, however, shown on both occasions an earnest desire to use her exalted position to do all possible to encourage the industries of our great Empire: an example which might be followed elsewhere, particularly by those who control the destinies in a large measure of India and the Colonies.

My own experience has been the same as others in finding it difficult to obtain reliable information from Government officials, or to excite the least interest in Government offices in the initiation and encouragement of an industry of vast importance to India, to East and West Africa, and to our Colonies in the tropics. At the Colonial Office and the Imperial Institute, the officials stated that they were too busy to give the matter attention; and at the Royal Gardens at Kew, where I applied for information as to seeds and roots, I was referred to a shop in Paris where the seeds could be purchased! I was under the impression that the Imperial Institute and Kew Gardens existed not as show places, but as sources of information in all that appertains to the products, vegetable and otherwise of the Empire, and I imagined that all that is known of ramie could be learnt in either place, but in this I was mistaken,

and my letters and requests were met with either blank disregard or chilling refusals.

If similar requests had been made to a Government office, a museum or botanical garden in Germany, the whole of the resources of learning of the institution would be placed at one's disposal, with the greatest alacrity and the most courteous willingness; and it is because national museums and institutes are in Germany the living sources of present-day information to the people, instead of being, as here, the lumber rooms of ill-described samples, that technical knowledge is there, not a matter of the class-room, but of the life of the factory, from the head downwards.

Failing thus to get information from Government sources as to the cultivation of ramie, but in confident anticipation of large orders which will consume an enormous amount of fibre, I turned my attention to the question of the supply of raw material. Having first gauged the present world's output in fibre and yarn, I brought myself by various means into direct personal communication with growers or would-be growers in almost every part of the tropical and semi-tropical world. When asked I gave instructions how to plant and to prepare fibre for the market, and I have succeeded in arousing a great deal of attention on the subject in places so widely separated as South America, East Africa, West Africa, West Indies, and India from Kashmir to Ceylon.

Everywhere I have tried to allay one bogey which has always frightened the intended planter, namely, that it is necessary to have a costly machine for decorticating the fibre in order to make it marketable. So long as there are millions of people in this world willing to work for 6d. a day or less, ramie is better, in such countries, stripped and decorticated by hand than by any machine that has been or will be invented. In India as in China, in West Africa, in East Africa where native labour is abundant, and in the West Indies, no decorticating machines are necessary; but in Mexico, in the Straits Settlements, in the Southern States of America, where labour is scarce and dear, and on the great rubber lands where ramie would be a valuable catch-crop, decorticating by machinery is essential.

A great many machines have been invented for this purpose since the Indian Government in 1869 offered two prizes, one for £5,000, and another for £2,000, for machinery or processes by which the fibre could be prepared at such a cost per ton as would render it easily marketable. This offer of prizes was renewed in 1877 for sums of £5,000 and £1,000. Various competitive trials were made, and though small prizes were awarded, no machine was found equal to the requirements of the Government, so some years ago the chief of the Economic Department advised the Indian Government to withdraw the competition.

This offer of the Indian Government to give prizes for decorticating machines was unfortunate, as it led those who were interested in ramie on a wrong tack: for it was more important to ascertain the correct scientific principles of treating the fibre in order to prepare it for manufacture, than to decorticate it by machinery on the fields, particularly in India, where, owing to the abundance of cheap labour, ramie can be better decorticated by hand than by any machine. China does not ask for decorticating machines, and the hand-stripped China grass —which is only ramie stripped and debarked on the fields with Chinese care and laboriousness—will always command a higher price in the market than any machine-decorticated fibre. Various machines claiming to do all that is required are now on the market, and I have reason to believe that a machine, the invention of a foreigner, which will be introduced in the autumn will give quite the best returns, both in the matter of perfectly cleansing the fibre of the outside brown pellicle and in the output it can produce per diem.

The difficulty of the whole proceeding will be understood by those who are not ramie experts if I briefly describe the process. Ramie stems, when grown to the height of about 8 or 9 feet, are, when matured, cut down, and the outer bark is at once stripped off. This outer bark, which can be easily stripped off, much in the same way as a willow cane is whittled, is found to consist of two layers, namely, a thin, outer, closely adherent, brown pellicle, and an inner, thicker, white, bast layer. It is this bast layer which is composed of ramie fibre. When it is stripped from the woody stem in the green state it is full of a sticky gum. The object is now to free the bast layer as much as possible of its soluble gums and of its outer brown pellicle.

This the Chinaman does by sitting in or near running water while he rubs off the outer brown pellicle with a blunt bamboo knife, and strips off the bast layer, washing away the soluble gums at the same time. The

long strips of fibre are then dried, baled and exported, and obtain a price per ton in Europe out of all proportion to the cost of cultivation and manipulation. In the case where the ramie stems are decorticated by machinery, they are sent, within three days of being gathered, to a central decorticating station; or in large plantations to the mill on the estate. The canes are first passed through corrugated iron rollers, which break up the woody stem and pith, leaving long strips of the bark more or less free from wood: these are then passed into a machine, the principle of which is, approximately, the same in all which have been invented, namely, that revolving steel blades pare off the outer brown bark of the ribbons, very much in the same way as the surface of a cloth is cut by a revolving cutting machine, and they are finally brushed clean of all adhering particles of pellicle.

The disadvantages of machine decorticating are—the initial expense of the machine; the delay in bringing the stems down from the plantations, so that some of the gums undergo fermentative changes; the smallness of the output of most of the machines in use, and the fact that after all the fibre is not so completely cleaned of its brown pellicle as in the case of hand stripping, nor are the fibres left in such a perfectly parallel condition, which is essential to avoid waste in the subsequent processes of spinning. I do not deny but that machines for decorticating are absolutely necessary in some cases, particularly where ramie will be grown on large plantations, and where labour is scarce and dear, but it has been unwisely put forward by the Indian and other Governments, as an absolute necessity before the cultivation of ramie had been entered upon on anything like a large scale.

I make bold, however, to say that though hand-stripped China grass will always command the best price for the finest ramie goods, yet for a large number of purposes it is not necessary to deprive the ramie of its outer brown pellicle. The whole bark, pellicle and bast layer, can be easily stripped off in long ribbons by hand, or the process may be aided by passing the canes through corrugated iron rollers to break up the wood and pith of the stems. These ribbons, which are known in the trade as brown ramie or rhea ribbons, must be thoroughly dried, and are then baled, and exported; and by those who hold the secrets, these brown ramie ribbons can be debarked and degummed at the same time, producing a very useful *filasse*.

This statement, made by me in many letters to growers in remote parts of the world, has given great hope and a considerable stimulus to ramie growers, as they were holding back, unwilling to plant on a large scale, waiting for the introduction of the long-promised, perfect decorticating machine.

The next process in manufacture is to free the fibre from its gum and to turn it into what is called *filasse*. The gums and pectines which bind the ramie fibres together in the bast layer are among the most irreducible and complicated in nature. Some of them are easily soluble in water, others can be reduced by alkalies, but some of them are more intractable, and the object of the investigators and chemists who have studied the subject of degumming ramie for the last 50 years has always been to recover the natural white fibre, free of its gums, without injuring its strength or destroying its brilliancy. To obtain this result numerous patents have been taken out, and still more numerous processes are kept secret. Some of the processes which were in use some years ago resulted in rendering the fibre so fragile that the yarns dissolved in powder after the cloth was woven. Some of the processes still in vogue render the yarns brittle in the extreme; but I may, nevertheless, say with confidence that the difficulty of degumming has now been solved, and that there are those among us who can teach, if they would, how to degum ramie without destroying its strength or diminishing its brilliancy.

One of the great arts of the process is to keep the long fibres of ramie intact and parallel so that very little tow is produced in spinning. It is often stated that it would be well to degum the fibre on the fields at the time of gathering and decorticating. This assertion I always contravert as degumming is essentially a scientific process, which must be watched over and directed by scientific experts; indeed every bale of ramie, and the product of every single crop, must be carefully examined and specially treated on its merits.

If ramie is to become, as we anticipate, one of the great textiles of the world, it will be grown, like cotton or sugar or rice, in plantations often widely separated, and frequently small in extent, and the great thing is to teach the planter how to prepare the fibre for export so that it may arrive at the mills in a sound con-

dition, and there is nothing that protects the fibre in the course of transit so well as to be embedded in its own gum.

After degumming, the fibre is then subjected to various manufacturing processes to turn it into sliver, and from sliver it is spun into yarn.

It is a strong commentary on the apathy of British manufacturers that, whereas there is only one spinning mill in Great Britain at present at work which treats ramie from the ungummed fibre to the yarn, there are several of large extent in Germany, France, and Japan; yet it is in England where the best ramie machinery is made, and these foreign mills come to England for their ramie-spinning machinery. I have reason to believe that this reproach to English industrial enterprise, will be removed before long; and, inasmuch as I and my friends are doing our utmost to stimulate the cultivation of ramie in British dependencies and colonies, we are also aiming at, and are taking practical steps for, making ramie-spinning a British industry.

To give now, before concluding, a short account of the methods to be adopted in the cultivation of ramie.

The ramie plant belongs to the nettle order, and is called "Boehmeria," after the German botanist, Boehmer. There are two varieties of the plant, namely, "Boehmeria Nivea," the under surface of the leaves of which is covered with white fluffy hairs, and the "Boehmeria Tenacissima," in which the leaves are green on both sides. The former produces the finest fibre.

The textile uses of ramie or rhea have been known to the natives where this plant grows wild for unnumbered centuries. It is stated that long before the Christian era muslin was made from ramie in India. In China, where it is the custom to dress in silk, those who cannot afford real silk use what is known as vegetable silk, which is ramie prepared by a long and laborious process by hand, the fibres of which are stuck together in an ingenious manner, so that there are no knots in the fabric from one end to the other. In India, the native fishermen have been accustomed from time immemorial to make cord for their fishing nets of ramie fibre, obtained from a patch of cultivation near their huts, the fibre of which is prepared and spun by the women; and I have recently learnt that in East Africa the natives are accustomed to make cord and weave baskets of extraordinary strength from the fibre of what is known as wild ramie.

In the successful cultivation of ramie, a medium, damp, equal climate is essential. If the temperature is too low, the growth will be slow, and if there are too great changes in temperature from heat to cold, or from a damp to a dry air, the quality of the fibre produced will be unequal; in fact, to produce fine fibre equal in quality, regular growth must be insured.

The soil is a matter of extreme importance; a loamy, sandy soil is the best, but it is above all things necessary that it should be well drained, and not liable to become waterlogged. Though the ramie plant will absorb any amount of moisture from the air, it is quite intolerant of standing water in the soil, and though the plant will endure long drought without injury, the roots will be killed in a few days by a swampy condition of the soil. In countries, therefore, where the rainfall is insufficient, or where it alternates with long periods of drought, irrigation must be resorted to, and in such cases crops of equal fine fibre can be depended upon.

The ramie plant can be cultivated by means of seeds, cuttings, roots, or suckers. The cultivation by means of seeds, takes too long to be recommended as a practical method for planters, and the best way is to grow by means of roots or suckers. The root of the ramie plant throws out suckers in the same way as do strawberries. On planting these they grow into independent plants in the course of two or three months, when they themselves also throw off a number of suckers, so that a few mother plants furnish, in a comparatively short time, the material for a plantation. The early lateral shoots are also cut off and are planted as cuttings. To keep the ground free of weeds is the chief care and expense of the planter, but as soon as the plants are well grown the weeds give no further trouble.

In preparing the soil it is necessary to plough it before planting, to the depth of a foot, and in this loosened soil the suckers should be planted to the depth of five or six inches, and at a distance of at least a yard apart. Every year the soil should be dug up deeply on either side of the row of plants, so as to give the roots air and to prevent matting of the roots with those of adjoining plants. This will lead, moreover, to a number of suckers being turned up, which can be used for the renewal or extension of the plantation. In this way a ramie plantation, instead of having a life of about 20 years, which is what is

generally reckoned, can be made productive for an incalculably long time.

The first harvest of a ramie plantation occurs with such satisfactory quickness that it cannot fail to be encouraging to the planter. Six months after the ramie roots are planted, the stems are ready to be gathered; in fact, in some countries, under peculiarly favourable conditions, such as in Cuba, the Pearl of the Antilles, Herr Hubert Boeken tells in a recent paper, published in the *Tropenflanzer*, of suckers planted on December 23, 1904, in a small garden in Havana, from which stems were cut on February 20, 1905, *i.e.*, eight weeks after planting, which measured five feet in height. After being decorticated in Aquile's machine, the fibre obtained from these young stems was sent to the ramie factory at Emmendingen, where it was pronounced to be of extraordinary beauty and fineness.

Under ordinary conditions, four crops of ramie stems may be counted upon every year, and under extraordinary favourable conditions, that is, where irrigation of the soil can be regular, six crops a year can be obtained. The most recent and careful experiments, quoted by Herr Boeken, give an estimate of 45 stems to every plant, that is on an average 180 stems per plant per year, or with 10,000 plants to the hectare,* 1,800,000 stems as the crop per year per hectare. The weight of this crop is estimated at 90,000 kilograms, and calculating that the stems yield 5 per cent. of fibre, a hectare of land should yield $4\frac{1}{2}$ tons of dry fibre, which would be equal to about 2 tons per English acre. This at £20 a ton would give a gross production of £40 an acre. Deducting 50 per cent. for the costs of working and treatment, £20 per acre would be the net value of the fibre produced, or £10 a ton, which would, however, find an easy market at £20 a ton.

Mr. John C. Johnstone, who has had many years practical experience of the subject in India, has put forward the tollowing figures as a rough estimate for planting an area of 3,000 acres and of the return for five years, assuming that the fibre is sold at £15 a ton, and the output is only one ton per acre.

The estimate of Herr Boeken—5 per cent. of dried fibre—is certainly a high one. Other authorities have given the output of fibre as between 2 per cent. and 3 per cent. of the stems, but this must obviously vary according to climate, rapidity of growth, and the thickness of the stems. As the cultivation of ramie becomes better understood, it will probably be found that certain strains produce a higher percentage of fibre than others; but however that may be, it is obvious that, granted the amount of fibre is anything between 2 and 3 per cent., the crop must be a very profitable one when one considers the high price of China grass. From £34 to £38 per ton is the market price of China grass to-day, and even at that price it cannot be bought in open market, but must be ordered for delivery three months in advance.

It is estimated by those well qualified to speak, that ramie or China grass can be cultivated in India, in East and West Africa and elsewhere in our colonies in the tropics; and

PLANTATION STARTED WITH ROOTS.

Years.	Area planted up each year.	Outlay each year.	Outturn per acre per annum.	Outturn Total probable tons per annum.	Value at £15 per ton.
	Acres.	£	Tons.	Tons.	£
First	200	3,159	$\frac{2}{3}$ of a ton	130	1,950
Second	200	4,819	One ton.	330	4,950
Third	400	7,207	Do.	666	9,990
Fourth	1,000	13,867	Do.	1,466	21,990
Fifth	1,200	24,620	Do.	2,600	39,000
Sixth	Conservation of 3,000 acres	26,448	Do.	3,000	45,000
	Total	£80,120			
	Net Profits ..	42,760			
	Grand Total ..	£122,880			£122,880

*A hectare is an acre of 10,000 square metres, and equals 2·470 statute acres.

can be hand-stripped and hand-decorticated, so that it is indistinguishable from Chinese China grass and can be put on the market at moderate prices which will yield handsome profits to the growers.

If such is the case (and I speak from absolutely reliable data), then surely the cultivation of ramie is a subject worthy the attention of the Indian and the Colonial Offices, and one for which the excuse of "having no time to attend to" is not defensible. There is here indeed a Chinese question of practical importance. Why should we go to China for our China grass, and pay exorbitant prices, and be at the mercy of the wire-pullers of the Chinese market, when the very best material could be obtained within the confines of the Empire at half the price, if only the capital were forthcoming to assist the planters willing to grow ramie in India, in East Africa, in Uganda, in the West Indies, and in the Straits Settlements, and if the roots were supplied and the technical information given by the Government bodies, whose duty it is to do this.

I have already kept you too long discoursing on the congenial subject of ramie, and as I see in this hall many well known experts whose opinions we should all like to hear on the subject, I will only conclude by saying that it is proved now beyond a doubt that ramie can be profitably grown, that ramie can be scientifically treated, and that ramie can be successfully woven, and it remains for the British public to say if ramie shall be one of the great British textiles of the future, to the benefit of the inhabitants of the East and West, the North and South, of this great Empire.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said he had been particularly struck with the record of patient pluck and perseverance which Mrs. Hart had shown in the development of the possibilities of ramie. There was no doubt that much could be done in the way of disseminating information throughout the Empire, and it was a great pity that the Imperial Institute, at the centre of the Empire, had not completely fulfilled its function as a bureau of information for business men here and for the Britons beyond the seas; and he hoped what Mrs. Hart had said with regard to what might be done, even by the remains of the Imperial Institute, would stimulate that department into a greater degree of activity. The ramie exhibited indicated the possibilities of a material which could produce such results. One of the bugbears of ramie in the eyes of the retail dealer was that it practically wore for ever. It was a magnificent fabric for railway cushions, or for any purpose where heavy wear was experienced, and it possessed the great advantage that it did not rot.

Mr. THOMAS BARRACLOUGH said he thoroughly agreed with the bulk of what Mrs. Hart had said, but he thought too favourable an estimate had been placed on the amount of ramie which could be produced. Even taking 2 tons per acre, the profit resulting was so enormous that it was safe to take a very low estimate. It was a great pity that the English Government did not value or appreciate the power they possessed for the purpose of facilitating new industrial undertakings. The exact opposite was the rule on the Continent. He remembered that when he was in Hamburg two or three years ago he was told in the course of one day by two different commercial gentlemen that they had been summoned to confer with Government departments in Berlin in connection with commercial matters in Japan and Brazil. That showed the diligence, intelligence, and "push" of the German Government, compared with the apathy and ignorance, of English Government departments. If the Imperial Institute were established on a practical basis, one of the first things it would have done would have been to collect information with regard to the growing of ramie, and to distribute it all over the colonies. By one mail he had received recently seven letters from East Africa asking how ramie should be grown and where plants and seeds could be obtained. That fact brought home to him the utter apathy of the English Government. He somewhat differed from Mrs. Hart in her remarks with regard to decorticating by hand labour. It was necessary that the fibre should be degummed as much alike as possible. It was very inconvenient to get a bale of ramie, one-half of which had beeu properly decorticated by good hand labour, and the other only half decorticated, owing to the fact probably that the work had been done by children, as was the case in China. If the ramie had a good deal of the outer pellicle left on it, it must be treated specially before it was degummed, whereas good decorticated ramie could be degummed straight away without any preliminary treatment. It was very necessary, therefore, that ramie should be decorticated equally. Hand labour was very good when it was good, but it was irregular, and machines must, sooner or later, take the place of hand labour. The Chinese decorticating was the best in the world, due to the fact that it was the custom all over China, where ramie was grown, for the payment for decorticating to be the perquisite of the wife and the children with which they bought their clothes. Hence the diligence with which they worked. There were two or three difficulties connected with the brown or black ribbons which were sent to this country. A great mass of stuff was sent over, on which freight had to be paid, which might just as well be left in the fields where

ramie was grown. As a consequence the material had to undergo special treatment, and even though he had known it to be bought for £13 a ton, it was dear at the price. Mrs. Hart had said that the plants would last for twenty years. In his opinion the outside limit to the age of a ramie plant was fourteen years, and probably twelve was nearer the average. If the roots were too old the fibre was deteriorated, and was worth considerably less for spinning purposes. But, as Mrs. Hart had said, the plants themselves provide so many means for obtaining new plants that it was not a serious consideration if the twenty years were reduced to twelve. The industry had now been put on a commercial basis. There was an immense demand for ramie yarn, in fact, so great was the demand that the largest mill in Germany was said not to be able to accept further orders for a considerable time. Consequently, if there was an ever-growing demand for the yarns in England and they could not be obtained except by going to Germany and France, it seemed to him that the English would be a very benighted people if they did not put up some spinning mills and spin the yarn they required. He hoped the excellent paper which Mrs. Hart had read would have a powerful influence in that direction.

Mr. W. F. WRIGHT said he had listened to many addresses on ramie, but he had never heard or read a more practical exposition of the whole question than that given by Mrs. Hart in her paper. Most people who desired to study the subject had been compelled to go to Germany, France, or America. The American Board of Agriculture had made special efforts to obtain useful information in connection with the cultivation of ramie, and investigators were sent to different parts of the world to find out the conditions which were suitable for the growth of the plant, and to obtain the whole history from A to Z from the agricultural point of view. He agreed with the remarks which had been made that there was nothing better than the hand-made grass received from China. He had seen specimens of the best machine-prepared grass, and thought there were a great many difficulties to be overcome before machinery could be usefully employed for decorticating, whereas there were only one or two in connection with hand labour. He disagreed with Mrs. Hart on one point, viz., he thought degumming on the spot, under the supervision of an expert chemist, was a much better system than allowing the gummy substances to harden and oxidise in the course of the passage of the ramie from the fields where it was grown to England. Mrs. Hart's experiment was the only serious attempt which had been made, as far as England was concerned, to put the industry on a progressive basis; and by her energetic labour she was dragging it from the dirt and mud in which it had been so long buried and was putting it on a clean platform.

Mr. C. E. COLLYER said it had been his contention for many years past that there was no difficulty in getting as much ramie and China grass as was required in this country. The only necessity was a certain market. If Mrs. Hart, instead of trying to teach the world to grow ramie, would devote her energies to the consumption of ramie, and cause a steady demand for it, he would guarantee to obtain for her, within a reasonable time, as much as she required. Some of the best firms in the City were willing to accept contracts for the supply, within reason, of any amount of ramie that manufacturers liked to order.

Lieut.-Col. ALLAN CUNNINGHAM remarked that ramie was indigenous to India, and no difficulty would be experienced in producing any quantity which might be required for manufacturing purposes in this country; and now that Mrs. Hart had demonstrated that it could be worked up into pieces of great length it surely ought to become a British industry. He hoped that Mrs. Hart, who had been such an energetic and persevering pioneer in the work and had brought the manufacture to such a pitch of perfection, would realise within her lifetime the proper financial results of her enterprise, an experience which did not fall to the lot of all pioneers. It might be of interest to the audience, if he stated that he was present at the trial of the machines which entered for the prizes offered by the Indian Government for a machine capable of decorticating and producing a fibre in a fit state for spinning. The machines were not a success; but he hardly expected at the time to live to see the day when such a result would be obtained

Mr. FRANK WARNER, after expressing his admiration of the way in which Mrs. Hart had conquered ramie, and converted it into the beautiful fabrics exhibited, said he spoke as a user of ramie yarn for the last ten years in conjunction with silk, and not as one who knew much about it in its productive stages. He had never used it as a warp, but as a weft he had used it most successfully, not only in producing damasks, but also brocatelles and various other fabrics. Used in that manner, it produced a beautiful fabric, and it took the dye in an admirable way with regard to fastness. He had used the yarns for many years for various fabrics sold for furnishing, and in no case had he received any complaints of the failure of the colour, which spoke volumes for the way the yarn took the dyes, because it was well known that cotton dyes almost invariably failed when exposed to the light in such fabrics. Mrs. Hart made no mention of ramie yarn displacing other yarns. In his own business he found that where he used ramie yarn it always displaced linen 2/20s. Ramie yarn cost 2s. 8d. per pound, but linen yarn of a finer count, which answered the purpose for most fabrics, could be obtained at about 1s. pound less. He agreed with Mrs. Hart that it was a splendid thing to encourage the growing of ramie

in India, but thought the remark equally applied to the growing of flax in Ireland, and unless he could see his way to a very great advantage in using ramie yarns he certainly inclined to the use of linen. There was one point on which Mrs. Hart did not do justice to ramie, in which ramie yarn had undoubtedly many advantages over linen. It was more silky in appearance, undeniably stronger, and when woven in a fabric for printing purposes, it excelled in taking colour. If the manufacturers could introduce ramie yarns at anything like an equal price to linen yarns, a great step would have been taken towards making ramie one of the great industries of the world. Finer sizes than had yet been spun were, however, required. He believed that 2/50s. yarn was the finest that had yet been produced, which could not be compared with the very fine sizes obtained in linen. There were many uses to which ramie might be put to which Mrs. Hart had not directed attention. Owing to its enormous strength, it might be most successfully used in the manufacture of ropes and twines, and in flag material where exceptional strain was put on the fabric. He had not yet heard whether the mercerisation of ramie yarns had ever been attempted. Mercerised cotton fetched treble the price of ordinary cotton, and it struck him that if ramie yarn could be mercerised, one of the most lovely yarns would be produced that had ever been seen. His experience of ramie yarn had led him to desire more of it, even using it only as a weft; but the great thing he had noticed in this country in connection with the subject was that whereas numberless linen yarns were brought in to the manufacturers day by day, the spinners did not bring samples of ramie yarn to their notice. There was a great opening for the British spinners to push the business, and if that were done he believed it would have a great future before it.

Mr. ZSCHOCHER said that ramie yarn was now spun up to much finer counts than 50, and the factory at Emmendingen hoped, in the near future, to be able to spin as fine as 100, 120, and perhaps 130. There was at present a great demand for ramie, not only for fabrics, but for underwear, as the fibre of ramie absorbed the perspiration, and was therefore considered beneficial; but while everybody in Germany and America used it for those purposes, the suggestion met with a very cool reception in England.

Mr. R. HART said that two very contradictory statements had been made in the course of the discussion by different speakers. In the first place, Mr. Barraclough had stated that the mills in Germany were so full of orders that no further orders could be booked till the end of next year, while Mr. Collyer had said that any amount of ramie could be obtained if only there was a demand for it. He thought it would be useful if those statements could be explained.

Mr. BARRACLOUGH, in reply to the last speaker, said the two statements had no connection. The German company had plenty of raw material, but was so full of orders for yarns that no further orders could be booked for some time to come. The reason ramie yarns were not offered to manufacturers, was that there were none to offer; on the contrary, the buyer sought out the spinner and paid the spinner's price. With regard to the question of spinning fine ramie yarns, the Castleton Company used to spin large quantities of ramie up to 100s. and sold at 8s. 6d. a lb. The question of degumming on the field had been raised. No buyer of ramie would buy an ounce of degummed ramie if he knew what he was about, some ramie mills in Germany have bought degummed ramie, spun it and sold it. A few months later it was returned to them because it had gone black and rotten, owing to the acid not having been entirely washed out of it. The managing director of a company told him that if anybody offered him bales of degummed ramie for nothing he would refuse them. Practical experience had proved that degumming would never take place on the plantations but at the mills.

Mr. W. F. WRIGHT said he qualified the statement he had made on the subject by saying, provided the degumming was carried out on the fields, under the supervision of expert chemists.

Mr. J. T. MURRAY thought there was nothing new in what Mrs. Hart had brought forward on the subject in her paper. Twenty years ago, representing an influential committee of the Manchester Chamber of Commerce, he went to Paris and saw ramie manufactured by Messrs. Favier, and brought back samples of the material, which, after that lapse of time, were as good to-day as they were then. The question, however, was whether the manufacture could be conducted on a commercial basis. If the eulogistic remarks which had been made about ramie were practical, how was it that the hard-headed Lancashire and Yorkshire spinners had not come to the assistance of those who were now working at the subject? It was simply due to the fact that the Lancashire and Yorkshire people had already lost a great deal of money on ramie. He thought, however, it would be of great advantage if a representative body of experts could be called together, to thresh out a subject of such national importance.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mrs. Hart for her excellent paper.

Mrs. HART, in reply, said that Mr. Barraclough had doubted the amount of the output of ramie per acre which she had given in the paper. She had simply quoted the figures recently published by Herr Boeken in the *Tropenflanzer* of his own cultivations

in Havana. The figures were high, and probably a larger output would be obtained in Cuba and such places, where vegetation grew rapidly, than in India. Mr. Johnson and Mr. Ashton, who were going out to India to carry out a considerable scheme of planting, calculated on a much more modest output than 2 tons per acre, but even with 1 ton the profit was very large. It was probably the case, as Mr. Collyer had said, that any amount of ramie could be obtained from China, but when it was wanted it was necessary to wait for a considerable time before it could be obtained, and even then a very much higher price had to be paid for it than it could be cultivated for in India, East and West Africa, and other British colonies. To lay down ramie, to cultivate it on the best principles, to strip it by hand, and to produce it so that it was indistinguishable from China grass did not cost more than £10 a ton. If this could be sold in the English market at £15 or £20 a ton, she did not see why they should draw upon China for thousands of tons at an average price of £35 a ton. One of the reasons she had given this paper was to try and stir up English capitalists and planters to grow ramie, in view of the demand there is for it within the Empire. Mr. Warner asked with what other yarn ramie competed. The most successful competition had been with the higher-priced cottons; and as there was no doubt they could make a fabric very much stronger than the most costly kind of cotton they could get a very large market in those products. With regard to the warp, the difficulty was in the inelasticity of the yarn in the loom. Some ramie yarns have a breaking strain of 18 lbs., and yet it is broken immediately at a knot; and that was the difficulty of weaving warp of pure ramie. Mr. Warner had asked, what was the effect of mercerising ramie yarns. Messrs. Favier had lately supplied them with mercerised yarns, but they were a good deal worse to weave than ordinary ramie yarns. It was not necessary to mercerise ramie. In mercerising cotton, the wavy microscopical character of the cotton fibre was destroyed in the mercerising, and the fibre was rendered perfectly straight. Under the microscope, ramie fibre was almost like a glass fibre, but if it was mercerised, no additional lustre was given to it, and its brittleness was increased. Very steady improvement was being made in spinning yarns of higher counts, yarns were now being spun up to 80 counts metric; and there was no doubt that very soon yarns of much finer counts still would be spun. She was able to speak with a good deal of hope as to the profitable nature of the manufacture of ramie. The company felt that although they had spent a great deal of money in making the experiment, they were confident of the future. The Lancashire mills failed in their efforts and lost money because they were hampered by trade tradiitions; it was only by modifying every one of the processes of manufacture, and not being hampered by the old traditions, that success with ramie was possible. The fact that the mills in Germany were so full of orders that it was difficult to cope with them, proved it was time for the English people should be up and doing, and see what could be done to make ramie one of the great staple textiles of the world.

PROMOTING BRITISH TRADE.

Mr. Alexander Finn, British Consul at Chicago, has printed a leaflet in which he explains how, in his opinion, British trade with the United States might be largely increased. Mr. Finn points out that whilst the total volume of British trade exports is growing it does not grow in proportion to the general increase of trade, and this applies especially to British trade with America. Taking 1905, the exports from Great Britain to the United States increased less than $3\frac{1}{2}$ per cent., while the total imports to the United States increased nearly 30 per cent. over those of 1904. On the other hand American exports to the United Kingdom, as well as to British Colonies, increased very rapidly, and this applies even to textiles. Agricultural implements, and many other kinds of machinery, seem to be winning their way in Great Britain, whilst in such lines as china, many kinds of novelties, glassware, pottery, handkerchiefs, burlaps, lace goods, in all these, including many lines of textiles, with the exception of dress goods, there is a decided falling off. Mr. Finn considers that the decay of the better class of British trade in America may be assigned to two causes: (1) A lack of realisation among American buyers of the superior quality of British goods; (2) The inertia of British manufacturers who will neither make the goods which satisfy current demand, nor push their wares so as to create a proper demand. British goods are made to last. German manufacturers give the public showy things, inferior goods at low prices. Americans prefer the cheap and showy. Many Americans, says Mr. Finn, "hardly expect a piece of furniture to last much over a year; china and glass ware is supplanted here by something of later fashion within a season or two. It has been said that when an American makes a purchase he (or she) is lucky to get home with it before it has deteriorated."

Mr. Finn thinks the Americans might be persuaded to buy better-class goods, but "quality alone is nothing, the quality must be known. And the business houses of England, Scotland, and Ireland have been slow to make the superior quality of their manufactures known in America." To remedy this Mr. Finn proposes "to start a permanent British exhibit in Chicago, now the chief distributing centre of America, our object being to acquaint American buyers more generally with the merits of British products, introducing many trade-marked wares to them which now are hardly known, if known at all. The local consulate is to be headquarters for the exhibit, and other British exhibits in other cities may

follow." Plans are not yet fully formulated, but considerable correspondence has taken place with English, Irish, and Canadian firms, and responses are favourable. The expenses to exhibitors will be slight, probably not over £20 a year for a permanent exhibit. It is expected that the exhibition will be started with a Canadian room for Canadian exhibits, an Irish room, a British room, &c. The Canadian room will have samples of flour, grain, and other Canadian products "which Americans might gladly buy if properly acquainted with the merits of the imports." In the Irish room "there could be a most interesting exhibit of Irish laces." As to Great Britain, Mr. Finn says, "there are scores of novelties, even agricultural products, not known here at all, which should be imported in large quantities from Britain."

OPENINGS FOR INDUSTRIAL ENTERPRISE IN MEXICO.

According to recent reports from Mexico, there is great activity there and many opportunities for manufacturers and capitalists to secure a share in the new progressive and prosperous movement now under way. Construction now proceeding of a new Mexican coast trunk line between Guaymas, Sonora, and Guadalajara, in the State of Jalisco, is said to be an impetus to the investment of capital in manufactures. The new line will pass through immensely rich mineral and agricultural sections of the Mexican Pacific slope in the State of Sinaloa, the territory of Jepic, and the State of Jalisco, the ports of which will be put in direct communication with the City of Mexico. Work is advancing on the new road at a rapid rate. Already several miles of steel rails have been laid, and it is said that 180 miles southerly will be completed and in operation by next August. Construction up and down from the port of Mazatlan, State of Sinaloa, is to be prosecuted, surveying parties being now in the field. Northerly from Guaymas the Sonora Railway is in operation, crossing the international line at Nogales, and connecting with the Southern Pacific Company at Benson. At the present time ore from Sonora must go to El Paso, a distance of about 300 miles, or to Canyon City, a distance of about 1,000 miles. There is, according to the American Consul in Sonora, a consensus of opinion that the time is ripe for the establishment of a customs smelter of great magnitude for the north-western section of Sonora, embracing in its limits mineral districts notable for fabulously rich deposits of gold, copper, silver, and lead, for quartz producers of unlimited wealth, as also for placers, the phenomenal wealth and future yield of which it is impossible to estimate. The State of Sonora is a vast mineral network—amongst the foremost of the mineral regions of the world—its mountains teeming with virgin wealth. The influx of American capital and energy goes on with remarkable strides, yet the State is not worked to the extent of one-hundredth part. Inexhaustible deposits of ore still untouched await the enterprising miner. About fifty miles by rail south-west of Bisbee are the Cananea copper mines, situated in the northern part of the Arispe district, where an American company has, within five years, developed one of the greatest copper mining camps in the world, upwards of 6,000,000 pounds of refined copper being sent to market every month. The mining lands of this company amount to 10,408 acres. The ores are of great extent and variety, including huge masses of oxides, carbonates, and sulphides, with frequent deposits of native copper, extending through a distance of fifteen miles along the main tract of the company. Numerous other companies, with extensive holdings, are working in the region at considerable profit. In the Cananea Mountains are many valuable undeveloped and partly developed copper properties awaiting capital and scientific management to make them important producers. The region is but one field in a great copper belt, embracing Globe, Clifton, Morenci, and Bisbee mines in Arizona, and traced through Cananea in the Arispe district, Nacozari in the Moctezuma district (where are the extensive properties of the Moctezema Copper Company), through the Sahuaripa district down into the Alamos district. This belt of copper runs parallel with a gold region, which extends down through the Magdalena, Ures, Hermosillo, and Guaymas districts, including Cerro Prieto, Providence, and Caliche, with the San Domingo and La Brisca placer fields in the Magdalena district, a district declared by Professor Hill, of the United States Geological Survey, to be one of the greatest gold-bearing regions in the world, reaching nearly fifteen miles along a river channel. To the westward the Jerome copper belt is traced down through the Altar and Ures districts across the Hermosillo and Guaymas districts, emerging at Santa Rosalia in Lower California. The Altar district is very rich in gold, both quartz and placer; leading quartz localities are El Trio and Cajon de Amarillas, placers at La Cienaga, Caborca, Boludo, &c. In the Altar district are deep placer grounds which are coming rapidly to the front. Sonura takes front rank with her silver mines. In the Magdalena district are the Planchas de Plata, Cerro Azul, and Mejia silver localities. In the Alamos district is the Quintera mine, turning out a monthly product of 50,000 ounces of silver, and La Sultana and Pedrazzini mines in the Ures district. Graphite is also produced in paying quantities. From this it is evident that Sonora presents an excellent market for mining machinery and supplies of all kinds.

As with the mining industry so with agriculture—Sonora furnishes a virgin field. Of dairy facilities and products there are practically none, butter being infrequent or absent at most tables. Sugar-cane is grown, and this causes a need for a sugar refinery in the northern part of the State of Sonora. In this connection it may be said that the agricultural districts of Sonora present ideal conditions for the

cultivation of the sugar-beet, looking towards the development of a great beet-sugar industry. Valleys, rich in alluvial soil, yield tobacco, wheat, corn, alfalfa, melons, vegetables of all kinds, oranges, limes, figs, grapes, pomegranates, &c. Agricultural machinery is needed in this district. The growing of oranges in Sonora has reached a noticeable place in the industries of the State. The greater part of the oranges go in transit to Canada where they have an equal market with the oranges of other countries. The customs duties imposed do not permit of their being marketed profitably in the United States. The Sonora orange is sweet and pleasing to the taste, resembling the Florida orange. The orange industry is in its infancy. There are vast areas, that have not been utilised, well adapted to orange growing, as also for the growing of lemons, figs, limes, pomegranates, and almost all semi-tropical fruit.

THE EXTENSION OF THE JAPANESE MERCANTILE MARINE.

Since the close of the war with Russia, Japan has entered actively upon the extension of its merchant marine, and there are indications of a purpose to make the Japanese flag supreme in Oriental waters. During the period of comparative quiet which followed the practical end of the war, and continued until the signing of the peace treaty, there was little evidence of the present-day activity in the Japanese shipping business, but now it is apparent on every side, and is especially noticeable in Shanghai, a port which will be used more in the near future by the Japanese than perhaps any other nation. The American Consul at Shanghai says that the magnificent water front owned by the Nippon Yusen Kaisha (Japanese Steamship Company, from which it was bought for a small portion of its present value) is occupied by a long line of pontoons and godowns, and from, and to, these a constant stream of cargo is being handled by Japanese steamers of light draught, which are not hindered by the Whanpoo bar. The regular and subsidiary ships of the Nippon Yusen Kaisha are being added to by coasting vessels, which will trade in all directions, even the Yang-tze service having been entered with determination. The activity of the Japanese carrying trade to the north is marked, and but recently by an agreement between the Nippon Yusen Kaisha and the Deshler line (under the American flag) of Kobe, there is provided a weekly service to all Korean ports *viâ* Moji, with Kobe and Shanghai as the terminal points. It is well understood that the Japanese are determined for the present to make Kobe and Moji their great shipping ports, and that Shanghai will be their Chinese base. It is anticipated that a line from Hongkong to Australia, *viâ* Manila, will soon be developed into a rival in importance of the trans-Pacific. In the meanwhile the shipbuilding companies of Japan are building new vessels, repairing old ones, altering captured craft, and in every way preparing to adapt everything they have afloat to the new field of Japanese endeavour. The consul says that the anticipation which is current in Shanghai that, unless unforeseen circumstances arise, there will be a wonderful Japanese fleet afloat which will cause every one of the nations now practically monopolising the sea traffic in the Orient to look to their laurels, is causing great uneasiness. The reason for this uneasiness is that many see in the prospect of Japan's extension of her mercantile marine a promise of the necessity for a frequent readjustment of freight, and a consequent diminution of profits. Those best informed predict entirely new schedules, and it is certain that many new plans will have to be devised to meet the competition. Whether Japanese vessels can be successful under these conditions is another question entirely. Not alone on salt water is Japan making her advance. On the Yangtze she is expected to have a large fleet, and upon the smaller rivers and canals as well. The carrying trade at Hangchow, *viâ* the Wangpoo and the Grand Canal, she already shares to a great extent, the service being conducted by small towing launches and lorchas. Soochow, Huchow, and other canal cities will also receive attention, and it is understood that her small coasting ships to places like Ningpo will be numerous. The Chinese apparently offer no impediment to these plans; on the contrary, they appear to welcome them. In no way is the evident determination of Japan to inaugurate a commercial conquest of the East more apparent than in the extension of her mercantile marine. Instances to prove this are numerous; in fact, as the American Consul says, one has but to inspect the present sailing lists of the Osaka, Shosen, and the Nippon Yusen Kaisha and its allied lines, to note that not a route has been forgotten at present. And in addition to that it is well known that the shipyards of Japan are the busiest places in the East to-day. The tonnage being prepared is enormous, and the work goes steadily on. No other city in China will feel the effect of this invasion so much as Shanghai.

TONNAGE MEASUREMENT.

In comparing the growth of the business of the port of Antwerp, as measured by tonnage in and out, with London and other leading ports, it is sometimes forgotten that the system of tonnage measurement in force in Belgium differs widely from that of the United Kingdom, of Germany, and the United States. In his report on the shipping and navigation of the port of Antwerp just issued (No. 3532, Annual Series), Consul-General Sir Cecil Hertslet considers in detail this difference, and it may be useful to summarise his explanation. The method of arriving at the net tonnage which is adopted in regard to sailing craft appears to be the same in both countries. In regard to steamships visiting Belgian ports the gross tonnage expressed on a vessel's certificate of registry is accepted as correct by the Belgian

authorities, and as a standard upon which to calculate the net tonnage, and the method of arriving at the net tonnage being that in force under the Moorsom system, the principle is identical with that in operation in the United Kingdom. The rule is as follows:— From the gross tonnage expressed on the certificate of registry are deducted:—

(*a*) The space actually occupied by, or required to be enclosed for the proper making of, boilers and machinery.

(*b*) The space occupied by coal bunkers, provided that such bunkers are permanent and so placed as to be in direct communication with the space allotted to the boilers.

(*c*) The space occupied by the shaft-trunks of screw vessels.

(*d*) The space occupied by covered constructions on the main bridge, the framework of the funnels, ventilators, and air shafts.

(*e*) Any space used exclusively for the accommodation of the master and crew, for the working of the helm, capstan, anchor gear, or for the keeping of charts, signals, boatswain's stores, &c., and the space occupied by donkey engines and boilers, &c.

This system is invariably carried out by the Belgian authorities, the actual amount of the total cubic space, determined as above, being deducted from the gross tonnage, and the net tonnage thus arrived at being entered in the official lists, and accepted as the net register tonnage of the vessel. This is in theory exactly in accordance with the system in force in the United Kingdom for determining the net register tonnage of a steamship, and it might be assumed that the net tonnage according to British and Belgian measurements is the same; but this is not the case, and the explanation of the apparent discrepancy is found in section 78 of the Merchant Shipping Act, 1894, which provides that:—"(1) In the case of every ship propelled by steam or other power requiring engine room, an allowance should be made for the space occupied by the propelling power, and the amount so allowed shall be deducted from the gross tonnage of the ship . . . and the remainder shall (subject to any deductions hereinafter mentioned) be deemed to be the register tonnage of the ship, and the deduction shall be estimated as follows (that is to say):— . . . in ships propelled by screws, in which the tonnage of such spaces (*i.e.*, engines and boilers) is above 13 per cent. and under 20 per cent. of the gross tonnage, the deduction shall be thirty-two one-hundredths of the gross tonnage." From this it is clear that, in the majority of cases in the United Kingdom, an average of 32 per cent. of the gross tonnage of the vessel is deducted from that tonnage in order to determine the net register tonnage, besides the additional deductions mentioned. That this 32 per cent. is in excess of the actual space contemplated for deduction according to the Merchant Shipping Act, 1894, is obvious in view of the fact that, whereas the British and Belgian systems of measurement are nominally identical, yet the difference in the total, when treating with a number of vessels of large tonnage, is considerably to the advantage of the Belgian navigation returns. At the present time vessels of all nationalities entering Belgian ports are assessed for their net tonnage in accordance with the Belgian system, which provides for a reduction by actual calculation and not by average. In defence of this system the Belgian authorities urge that were it inaccurate, or in any way unfair, objections would be raised by the owners of the vessels frequenting Belgian ports who are required to pay port dues on the net tonnage, and that no such objections are made. Sir Cecil Hertslet sums up his remarks as below:—(1) Though the systems of tonnage measurements in force in the United Kingdom and in Belgium are theoretically identical according to law in actual practice the Belgian system is the more favourable in regard to the compilation of statistics. (2) There being a difference in the modes of calculating the net tonnage measurement of vessels, no correct basis exists for drawing an accurate comparison between the statistics of the tonnage of vessels visiting the great ports, the reduction of 18·5 per cent. from the Belgian statistics being an average one only, which would fluctuate in any case, and particularly if the number of sailing vessels entering the port of Antwerp were to vary. (3) The Belgian net tonnage measurement is in every case calculated mathematically, whereas the net tonnage in the United Kingdom and in Germany is determined to a great extent upon an average deduction. There remains to be discovered some basis upon which the tonnage of the great ports can be compared which, under the existing conditions, appears to be impossible, unless, for the sake of comparison only, the gross tonnage of shipping were to be taken in order to obtain the desired end. As illustrating the extent of the difference in measurement, Sir Cecil Hertslet gives a comparison of 263 British vessels entering the port of Antwerp during the month of July, 1905, measuring according to Belgian figures 414,556 tons. The same 263 vessels, according to the net tonnage expressed in their English certificates of registry, measured only 337,773 tons; therefore for the purpose of comparison of the total tonnage of the port of Antwerp with those of ports of the United Kingdom and Germany, it may be said that an average percentage of 18·5 per cent. should be deducted from the Belgian figures for the port of Antwerp in order to permit of the comparison being made upon an equal basis.

THE NEWSPAPER PRESS IN CHINA.

The status of the newspaper business in China at the present time is interesting, both from a business and a sociological standpoint. As might be expected from the radical difference between the Chinese and foreign languages, there are two kinds of newspaper and publishing business, one foreign (generally

English) and the other Chinese. It is rather surprising, in view of the comparatively small foreign population in China, how many publications there are in foreign languages. Shanghai has five daily newspapers, three morning and two evening papers, one in French. It has six foreign weeklies, one in German. It has also four Chinese dailies and a large number of Chinese weeklies. In addition there are a large number of religious papers, mostly in Chinese, published by the mission authorities for the several missions, to be used in connection with their work in various parts of the Empire. Some of these mission publications have a large circulation, and are forming an important factor in the regeneration of the educational and social system of the nation. In the south, according to the reports of American Consuls, Hong-Kong dominates the publication business, and as it is a British colony, English publications might reasonably be expected to lead, but on the face of the record, the Chinese predominate. There are four English dailies. There are six Chinese dailies, and as in the case of Shanghai, there are a large number of publications designed to fill various wants in South China, a Portuguese weekly, and the Government Gazette being among them. In nearly every port of importance in China there is an English publication of some sort. Tientsin has good newspapers, considering their support; Amoy and other ports are also provided with periodical publications. The publishing houses, as a rule, both newspaper concerns, and concerns for general printing only, are fairly well equipped for their work. Some of them attempt work in the line of high class magazine and book publishing, and while it is not always an unmixed success from a technical typographical standpoint it demonstrates that the Chinese workmen, who do most of the work under foreign supervision, will in time acquire considerable success in this direction. Practically all the establishments are equipped for more or less printing in the Chinese language, and some of the newspapers devote a portion of their space to a short review of the news of the day in Chinese. This work, of course, requires a special staff, but it also brings its special returns, and is probably an advantage rather than a drag in the business. Some of the concerns have the latest modern machinery. The newspapers, as a rule, lean to British machinery wherever possible. The circulation of the newspapers in Chinese ports does not justify large and high speed printing machinery. All over the Empire, native newspapers are being started in the colloquial dialects, and are more or less local in character. The result is that many irresponsible publications are issued, and the means used by their projectors to keep them alive, have a striking similarity to those employed by irresponsible parties at various times and in many places, particularly in the United States. Newspapers are established, run a short course, and then drop out of existence. Blackmail and other evils afflict many communities. Much of the anti-foreign agitation which has caused so much trouble in China in the past few years is to be traced to such publications. In time some of these papers, like some of their prototypes in other lands, develop into paying properties and reputable publications. It is unfortunate in some respects that the publication of newspapers in the several local dialects has developed so generally. While such publications will afford means of educating the people of the Empire in some directions, they also furnish the means for deepening the gulfs dividing the several provinces which differ in dialects. Each newspaper centre, if it performs its natural mission, will develop its own language in its own field to the exclusion of a language which might in time become common for all China. It is easy enough, says Consul Anderson of Shanghai, to criticise newspapers anywhere and in any land, but it is not always easy to improve such newspapers, when their support, their origin, and their particular field are considered. There is a widespread impression that most of the foreign publications in China are making money to a very satisfactory degree. The proprietors secure an extraordinary, one might almost say an extortionate price, for their papers, and secure good rates for their advertising columns.

THE MACHINE-MADE LACE INDUSTRY IN SAXONY.

In the industry of machine-made lace, that has in recent years attained such proportions in Plauen, a decided advance in prices is now recorded. This is due to the two-fold proprietorship, wherein one person furnishes the machine and thread, and another—the manufacturer proper—the designs, and afterwards exploits the laces as a commercial enterprise. Although long known to the merchant, it is becoming recognised generally, according to the American Consul at Plauen, that there is every possibility in Plauen lace. Not only are many of the hand-made laces conventional design followed with marvellous fidelity, but new effects of exquisite delicacy are offered daily by local manufacturers. On the other hand, some very fine patterns of Plauen origin are imitated as closely as possible with coarser thread, and put together with less skill and care, so that the goods are disposed of at prices so low that the recent increase will not reduce the bulk of manufacture. Localities that produce hand-made lace find it necessary to import Plauen manufactures in some of their manifold varieties in order to supply a demand for lace of everyday use. Consequent upon the delivery of the hand-made laces, and the weeks often consumed in their fabrication, the cost of some pieces is so excessive that it is only within the reach of the especially fortunate to acquire them. In spite of the advance in price, which will range from 10 to 30 per cent., machine-made lace, in fairly any gradation of value and design, will remain so far below hand-made lace that the one will still exist an artistic luxury, obtainable in very limited quantities, while the other will be a commercial

article, the output of which can always meet the needs of the market, and at the same time be such a close approximation in texture and elegance to the hand-made lace with additional advantage of daily utility, that the difference will affect only the expert and the wealthy. Exporters from the Plauen lace district are at present very much interested in the revival in France of the hand-made lace industry. The different varieties of real French lace, such as Alençon, fine Valenciennes, Auvergne, and Cluny have become known the world over for their beauty and the individual character of the designs of the various lace-producing localities, and were at one time more largely used. The decadence that affected this art was due chiefly to the rapid development of machine-made lace for dress effects. The manufacturers of Plauen succeeded in producing surprising imitations of the existing established patterns, and easily went on to a greater excellence, with perfected mechanical devices, and highly-trained artistic designers, until the industry has become creative to a surprising extent. It is stated that the district of Plauen alone possesses some 3,000,000 patterns. The fact that hand-made and older laces, whose range is limited, can faithfully be reproduced, is only a secondary factor in the great Saxon industry.

THE NATIVE INDUSTRIES OF BRAZIL.

The two most important native industries in North Brazil are the cultivation of sugar-cane and cotton, both of which grow in profusion, and in regard to these, a special agent who has recently been commissioned by the United States Department of Commerce to investigate the trade conditions in South America, says that "nature has perhaps been too indulgent to the inhabitants, for the soil and climate produce the commodities in question in such profusion, and with a little assistance from man, that there is no incentive to especial effort, or the introduction of improved methods." Sugar-cane and cotton grow wild over a large part of Pernambuco, Parahyba and Rio Grande do Norte, and the native does but little except to see that his little patch is occasionally weeded, that the stalks of the cane are occasionally cleared, and that the crops are gathered when ripe. In neither sugar nor cotton is there anything which corresponds to the "plantation" system of Cuba or Hawaii, or of the Southern States of America. Some of the sugar mills do, it is true, hold and cultivate sugar lands, but the relative area of such holdings is small, and the mills in general are content to let the native cultivate the cane on his small "farm" and to purchase the product from him when it is gathered. In regard to cotton, this statement is of even more universal application. In no case has the cultivation been undertaken on a large scale; the natives grow it on their small holdings, harvest the crop, and sell it to the factory or to the exporter. The native methods are crude in the extreme. When it becomes necessary to set out new sugar plants it is done in the usual fashion by cuttings from the old, but with little of the systematic regularity which is seen on a Cuban or Hawaiian plantation. Then the field may be neglected for months. When the time for ripening approaches, the stalks are cleared of all the lower leaves in order to permit freer access to the sunlight. After that the only work remaining to be done is to cut the cane when it is fully ripe. The next year even the process of planting is dispensed with, the new crop being allowed to spring up spontaneously from the roots of the old, remaining in the ground, and these spontaneous crops are then gathered for five, six, or even as many as ten successive years, until the yield becomes so small as to render a replanting imperative. This growing of spontaneous crops from the old roots is by no means unknown in other cane-producing regions of the world, but in modern plantations the efficient limit of the system is considered to be two, or at the most three, crops before a replanting. In short, there is nothing of the large cultivation, the use of machinery and labour-saving devices, the efficient organisation, which are now considered essential in the greatest sugar-producing countries. Yet in Northern Brazil the possibilities are probably unequalled in any part of the world. No irrigation is necessary, as in Hawaii. The crop matures in twelve months, as compared with eighteen months in Hawaii and Cuba. There is abundance of cheap labour, and the sugar lands lie comparatively near to good shipping ports. Not only does the absence of modern methods pertain to the growing of the sugar-cane, but it affects, though in less degree, the mills of the country. In the native mills, or "usinas," this might be expected, but it is rather surprising to find it in those established by foreign capital. The primitive native mills are, it is said, satisfied if they get 7 or 8 per cent. of sugar from their cane; the foreign mills get as much as 12 per cent. A properly-equipped mill in Cuba is said to get as much as 17 per cent. What has been said in regard to sugar applies equally to cotton. It grows almost without cultivation as a perennial. The native with a hoe as his single implement keeps his little field free from the coarser weeds, and when the crop is ripe he picks it. The result of this neglect is that the fibre, though naturally a long one, is shorter than it should be, and is very coarse. It is said to be fit only for weaving the coarser and poorer grades of cloth. In mills established by, or under English influence, better methods seem to have been employed, and the industry is generally regarded as a flourishing one. Even in these establishments, however, it is said that there has been a falling off in excellence since the substitution of native for foreign management. In addition to these principal industries of sugar and cotton, there are numerous others carried on on a much smaller scale. Among them may be mentioned brick and tile making, the manufacture of cotton seed and castor oil, soap and candle works, one or two large match factories, &c.

HOME INDUSTRIES.

The Coal Duty.—The revenue of the financial year ended on Saturday last is so much better than the late Chancellor of the Exchequer anticipated when he submitted his estimates—£1,523,000—and the reduction in expenditure has been so considerable, that the Chancellor of the Exchequer will have a surplus balance so large—between £2,000,000 and £3,000,000—that he may conceivably see his way to repeal the coal tax. In his reply to the miners' deputation that waited on him on February 21 Mr. Asquith made it plain that he would like to see it repealed. "He was quite satisfied that the tax ought not to form part of the permanent fiscal arrangements of the country." The tax was imposed in 1901, and with the exception of that year the output has continued to increase although the average increase for the five years 1901-5 was less than for the preceding five years. The output for last year—236,111,150 tons—was the highest ever recorded, and no less than 10,929,850 tons in excess of the output for the year immediately preceding the imposition of the tax. But it may be taken that it would have been larger but for the tax. Low freights have had a good deal to do with increased exports. As the Royal Commission pointed out in their final report, the statistics show that the exports to some markets, notably France, Belgium, and Holland, have been reduced, especially for coal from the Swansea and Llanelly districts, and from the Humber ports. The conclusion of the Royal Commission may be taken to be that of the Chancellor of the Exchequer, namely, that "an export duty must restrict the tonnage exported, and that the burden of the tax presses relatively more heavily on that coal which in value is slightly over the margin of price at which coal is exported free of duty."

Beer and Spirits.—The receipts from Excise have fallen in round figures over half a million—from £30,750,000 to £30,230,000—and in face of the increases in other sources of revenue affected by the general prosperity, or otherwise, of the people, this falling off lends support to the contention that the nation is slowly learning the virtue of sobriety. The highest point was reached in 1900-01, when the Exchequer received £33,100,000 from Excise; next year the amount fell to £31,600,000; in 1902-3 it recovered to £32,100,000, and since then the fall has been continuous, to £31,550,000 in 1903-4, £30,750,000 in 1904-5, and £30,230,000 in 1905-6. And this in spite of growth of population. The heaviest falling off is in the spirit duties. In 1899-1900 the Exchequer received £19,335,360 from this source, in 1904-5 only £17,306,983, the decrease being continuous since 1902-3. The receipts from the beer duty in 1900-01 were £13,490,620 in 1904-5 they had fallen to £12,678,832. In 1899-1900 the estimated consumption of beer per head of the population was 32·28 gallons. Year by year since then it has fallen, until last year it was only 28·44 gallons. So with spirits, the number of proof gallons of spirits of all kinds retained for consumption per head of population in 1899-1900 was 1·17 gallons, and—with the exception of 1902-3, when there was a recovery of 0·2—the fall was continuous to last year, when it was only ·93 gallons per head of population. If the fall continues it must seriously affect the incidence of taxation. More and more of the population will be temperance men, and under our system of taxation the working man who avoids beer and spirits can view the growth of expenditure with something like equanimity.

The Telephone Service.—How is it that the telephone service has en so little developed in England and in Europe generally, and so highly developed in the United States? Discussing this question in *The Times*, Mr. H. L. Webb, who speaks with authority on the subject, says that the fundamental cause is that in Europe telephony is a Government monopoly, and not a field in which private enterprise has been free to do its best for itself, and for the community at large. In America, there is no Government telegraph or telephone monopoly, and both industries have been free to extend in a normal manner, and as legitimate business enterprises, with results entirely satisfactory to the public. No observer, says Mr. Webb, can be three days in an American city without noting that the telephone service is a highly developed part of the current machinery of business and social life, and that it is employed by almost all classes of the community. But it is only in America that the telephone service has reached this high pitch of development, efficiency, and popularity, and Mr. Webb's explanation of the contrast is that whilst in America the telephone service has been treated as a friend, in Europe it has never been treated as a legitimate business enterprise, and has never had a fair field. It has been treated as a mere offshoot of the telegraph, and it has occupied the position of Cinderella in the family of methods of communication placed under Government control. The American telephone manager has not had to reckon with artificial restrictions imposed to hinder the development of his business, and he has put efficiency in the forefront, efficiency in construction and equipment, in maintenance, operation, and general organisation, not frightened at the cost, since the American public has always been willing to pay for efficiency, and has preferred it, even at relatively high charges, to merely low prices without high efficiency. In Europe it has been different. The Governments have not been willing to make the service really efficient, and they have been equally unwilling to give a free hand to others ready to do it. As a result, the public of European countries do not know what an efficient and highly developed service really means; and think only of cost. It is only the Americans who from the outset have recognised the truth that high efficiency and wide development are more important to the community as a whole than the cost of the

service, since an efficient telephone service means saving of time and labour, economy in production and distribution, even saving of life and property.

The Vanadium Steel Industry.—For many years soft or "mild" steel has been taking the place of wrought iron for structural purposes but now a demand has arisen for steel of much greater tensile strength, and it would seem as if the time is near when the use of hard and tough steel will become much more general. The principal difficulty hitherto experienced in the use of hard steel of great tensile strength has been its brittleness, but some of the new alloys are said to possess the necessary strength without excessive brittleness. In a paper read by Mr. J. Kent-Smith to the Liverpool Section of the Society of Chemical Industry a few days ago it is stated that Messrs. Willians and Robinson are now producing special vanadium steel alloys at the rate of 800 tons per annum at their Queensferry works. The ferro-vanadium used for the manufacture of these special alloys is got from the Llanelly works of the new Vanadium Alloys Company in South Wales, and contains up to 30 per cent. of vanadium. The vanadium steel industry is altogether an English industry, and 80 per cent. of the production is now being taken by the motor-car and motor-omnibus manufacturers of this country. The advantages of the use of steel of relatively high tensile strength is evident since the total weight of metal can be greatly reduced, and in steel trusses and girder work a diminution in weight of 50 per cent. can easily be obtained. The manufacture of the modern motor car has given a great impetus to the production of improved qualities of steel. The highest test yet obtained from a chrome-vanadium steel, after special treatment, was a maximum breaking strain test of 103 tons per square inch, this steel showing at the same time great resistance to dynamic and torsional tests. This is a combination of qualities which has never been obtained before, and is the peculiar feature of the chrome-vanadium steels.

China Clay.—Many of the workings for clay and brick earth are less than 20 feet deep, and so escape the operation of the Quarries Act, under which returns are compulsory, so that the official statistics of production are incomplete, but there are few counties in England which do not produce minerals employed in the manufacture of bricks. Beginning with the Coal Measures, there are mines and quarries producing fireclay on a very large scale. Permian strata are also largely worked, as well as various beds in the Triassic, Jurassic, and Cretaceous rocks. The Tertiary beds of the South of England afford much clay for making bricks, tiles, and pottery. The china clay is derived from granite decomposed, and is only worked in Cornwall and Devon. In 1904, the export of china clay and china stone from these counties amounted to 641,094 tons, as compared with 576,173 tons in the preceding year. There is now a scheme on foot for developing the china-clay deposits on the southern slopes of Dartmoor. Practically the only works of the kind at present in operation in Devon are those carried on at Lea Moor, the produce of which is brought down to Plymouth for shipment. The site of the new works is more to the eastward, at a place known as Redlake, near the source of the river Erne. There is considerable local opposition to the new scheme on the ground that it would be injurious to the riparian owners to have any of the water of the rivers diverted, and to the district in general for the water to be discoloured, but apparently the consent of the Duchy of Cornwall has been given to the establishment of the new works. Some years ago a company with a large capital was formed with the object of obtaining the control of the whole of the china clay industry in Devon and Corwall, but it was not in good hands, and ended in disaster.

The Automobile Industry.—Some official figures just published relating to the American imports and exports of motor cars deserve the attention of British manufacturers. In 1904, 423 motor cars were imported into the United States at a value of 1,446,303 dols., and of these 368 came from France, 22 from Germany, and only 15 from the United Kingdom. On the other hand over 50 per cent. of the American motor cars exported went to British territories, the value of the exports to the United Kingdom amounting to 707,045 dols., to France 265,703 dols., and to Germany 105,457 dols. It is estimated that there are 70 establishments in the United States making or dealing in automobiles. The capital exceeds 20,000,000 dols., and the output is placed at about 45,000,000 dols. It may be hoped that before long these concerns will find a less ready market in the United Kingdom. Our manufacturers ought to be able to supply the home demand. Anyway such great dependence upon America cannot, or ought not to be, lasting.

GENERAL NOTES.

BRAZILIAN TRADE.—In view of the growth of the German settlements in Brazil, and the enterprise of the German settlers, it is a little surprising to find that German trade with Brazil is not, relatively to that of other countries, more important. In his report upon the trade of Brazil just issued (No. 3540, Annual Series), Mr. Consul-General Chapman gives statistics which show that of the export trade of Brazil 50 per cent. goes to the United States, 16 per cent. to the United Kingdom, and 13 per cent. to Germany. British shipping entered shows an increase on the year of 104 vessels, and 237,599 tons, whilst German shipping shows a falling off of 27 vessels and 52,841 tons. Mr. Chapman points out that with the exception of cotton, the raw material, and partly manufactured materials including cotton

yarn (the spinning of which in the country is on the increase), are imported. The cost of production in Brazil is far greater than it is abroad, and the quality of the turn-out inferior. The bulk of the capital invested in the industries is foreign, and the machinery, management, and skilled labour are foreign. These concerns have accumulated wealth, have acquired considerable influence in the country, and by agitating for protection have from time to time obtained a rise in duties on foreign goods which in some cases have become prohibitive.

PORT WINE.—At a recent meeting of British shippers of port wine from Portugal a resolution was passed, with very little dissent, expressing the opinion that the true definition of port wine is wine exclusively from the Douro, but in his report on the trade of Oporto just issued (3537, Annual Series) Mr. Consul Grant says that a large proportion of wine not from the Douro district has been and is being shipped as port. Up to 1865 restrictions imposed by the Portuguese Government prevented wines other than that of Douro origin from being shipped from Oporto, and until the railways were constructed the cost of transport of wine from the south of Portugal would have been very heavy. In 1865 the phylloxera began to make its influence felt in the Douro, and subsequently reduced the production of that district to such an enormous extent that merchants wishing to supply wines at a cheap price began to buy some from other districts as well as from the Douro. During the last twenty years replanting in the Douro has gone on steadily, and now that they are in a position to supply the quantities of wine required for export Douro farmers are naturally anxious that shippers should buy only from them the wine to be shipped under the old name. But a regular trade has been established in wines from other districts, either alone or blended with Douro wine, and exporters are opposed to any sort of restriction. Most shippers, Mr. Consul Grant says, are agreed that if a distinction could be made between Douro and other wines, only the former being entitled to the name of port, the trade would be benefited, inasmuch as the consumer who asked for port would get a genuine Douro wine.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

APRIL 25.—"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT (of the firm of Messrs. Raphael Tuck and Co.).

MAY 2.—"Submarine Signalling." By J. B. MILLET.

MAY 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By PROFESSOR THOMAS OLIVER, M.D., LL.D.

MAY 16.—"The Development of Watermarking in Hand-made and Machine-made Papers." By CLAYTON BEADLE. SIR FRANCIS HAYDN GREEN, BART., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

APRIL 26.—COLONEL SIR ARTHUR HENRY MCMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

MAY 8.—"Damascening and the Inlaying and Ornamenting of Metallic Surfaces." By SHERARD COWPER-COLES.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 9...Geographical, University of London, Burlington-gardens, W., $8\frac{1}{2}$ p.m.

Medical, 11, Chandos-street, W., $8\frac{1}{2}$ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., $4\frac{1}{2}$ p.m. Dr. William Woods Smyth, "The Bible in the Light of Modern Science."

TUESDAY, APRIL 10...Hellenic, at the Rooms of the Society of Antiquaries, Burlington-house, W., 5 p.m.

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. 1. Mr. Ernesto Stassano, "Note on the Rotating Electric Steel Furnace in the Artillery Construction Works, Turin." 2. Mr. C. A. Keller, "Electrothermics of Iron and Steel." 3. Mr. Gustave Gin, "Recent Developments in the Gin Electric Steel Furnace." 4. Mr. H. S. Coleman, "Note on the Cleaning of Work by means of the Electric Current."

Medical and Chirurgical, 20, Hanover-square, W. $8\frac{1}{2}$ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Dr. T. E. Stanton and Mr. L. Bairstow, "The Resistance of Iron and Steel to Reversals of Direct Stress."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. C. J. Drac, "A Geometrical Method of Photography in Colours."

Zoological, 3, Hanover-square, W., $8\frac{1}{2}$ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. The Hon. Walter James, "Australian Immigration."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, APRIL 11...Association of Engineers in Charge, St. Bride's Institute, Bride-lane, E.C., $7\frac{1}{2}$ p.m. Sir Charles Forbes, "The Origin and Progress of Acetylene, and its Adaptability to Various Uses."

Japan Society, 20, Hanover-square, W., $8\frac{1}{2}$ p.m. Prof. J. Takakusu, "Buddhism as we Find it in Japan."

Royal Literary Fund, 7, Adelphi-terrace, W.C. 3 p.m.

Astronomical, Burlington-house, W., 5 p.m.

Journal of the Society of Arts.

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FRIDAY, APRIL 13, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, March 15; SIR CHARLES JAMES LYALL, K.C.S.I., C.I.E., LL.D., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said the Section had met to hear an account of a great undertaking, the Linguistic Survey of India, from the man who had carried it out from the beginning. Dr. Grierson had had a long and honourable career in the Indian Civil Service, and had been able to combine with the active and absorbing duties of a district officer, distinguished above all things by an intimate knowledge of, and sympathy with, the people, a minute study of their languages in the districts where he had served. His labours on the Survey had met with very wide recognition, both in the United Kingdom and on the Continent; and at the last three Oriental Congresses, which were held at intervals of three years, the report on the progress of his work had been greeted with unanimous applause and admiration by the assembly of learned men there gathered together. That would, he was sure, be a sufficient guarantee that the audience would listen to a master of his subject.

The paper read was—

THE LANGUAGES OF INDIA AND THE LINGUISTIC SURVEY.

BY GEORGE A. GRIERSON, C.I.E., Ph.D., D.Litt.

(Honorary Member of the Bengal Asiatic Society, of the American Oriental Society, Foreign Associate Member of the Société Asiatique.)

The paper which I have the honour to read to-day is entitled "The Languages of India and the Linguistic Survey," and when I sat down to write it I hoped that I should be able to give a summary of both these subjects within the allotted limits. But I soon found that this was impossible. Each branch would take nearly the whole of my time, and to attempt to describe both would result in describing each with parallel incompleteness. I shall, therefore, devote most of my remarks to one side of the whole question—the Linguistic Survey. I shall do so, because less is known about it, and because its operations have been in their way unique. I believe it is the first occasion on which any Government has set to work on a systematic investigation, as accurate as circumstances permit, into the facts concerning all the forms of speech current within a large definite portion of its dominions. The account of the survey will not be put forward as that of a model for similar enterprises in future, but rather as a record of experiences showing what can be done, and pointing out what pitfalls are to be avoided.

I regret that much of what I shall say will necessarily be a somewhat prosaic account of a voyage which has been hitherto apparently free from any dangerous rocks or violent tempests, but that will be preferable to wearying your ears with long catalogues of languages, even the names of which are hardly known. I intend also, if time permits, to give a summary of the results of the Survey, and of the general condition of linguistic affairs disclosed by it.

Let me commence with a rapid historical review of previous attempts to catalogue the languages of India, and, claiming the privileges of my Irish nationality, I venture to tell you first of a linguistic survey, wider and more complete than even the present one, which is decidedly not historical. The legend comes from the Pashto country on the north-western frontier of British India. It is said that King Solomon sent forth his Grand Vizier Asa to collect specimens of all the languages spoken on the earth. The official returned with his task accomplished. In full darbâr he recited passages in every tongue till he came to Pashto. Then he stopped and produced a pot in which he rattled a stone. "That," said

he, "is the nearest approach which I can make to the language of the Afghans." Coming down to sober fact, it may be mentioned that the earliest notice of the Indian vernaculars which I have seen is that of Terry, who, in "A Voyage to the East Indies," published in 1655 A.D., informs us that "the vulgar tongue of Indostan hath great affinity with the Persian and Arabic tongues; but is pleasanter and easier to pronounce. It is a very fluent language, expressing many things in a few words." Passing over isolated accounts of single languages and Ketelaer's Hindostani grammar (circ. 1715), we come to the inquiry into the languages of India, which is to be found in the correspondence of La Croze, librarian at Berlin 1667-1739. He and his chief correspondent, Theophilus Siegfried Bayer, busied themselves chiefly with the various Indian alphabets, and it was Bayer to whom the credit belongs of first in Europe reading the well-known Buddhist formula, "Om mani padme hum," although he did not succeed in translating it. About this time there were compiled collections of the Lord's Prayer in various languages, such as the "Sylloge" of Chamberlayne (1715), and the "Sprachmeister" of Fritz (1748), both of which contained many Indian examples. In 1761, a Capuchin missionary, named Beligatti, published, in Rome, the "Alphabetum Brammhanicum seu Indostanum Universitatis Kasi," to which Amaduzzi supplied an elaborate preface, summing up all that was then known regarding the languages of India. He mentions Sanskrit, which he calls the language of learning, and then, as vernaculars, the dialect of Benares, which he calls "Bekà Bolì," and the "Linguæ populares," *i.e.*, Bengali, Tirhuti (*i.e.*, the Maithili dialect of Bihari), Naipali, Marathi, Peguan, Singhalese, Telugu, and Tamil. It will be observed that the list is very incomplete and, moreover, includes as a separate language, a form of speech (Maithili) which we now reckon as a dialect. The next stage is the "Symphona" of Abel, published at Copenhagen in 1782. He described eleven Indian languages, the new ones being Canarese, the Konkani form of Marathi, and Gujarati. Finally, Adelung's "Mithridates" (1806 and following years) gives a *résumé* of all the linguistic learning of the eighteenth century, and forms a link between the old philology and the new.

In the meantime the missionary Carey had landed in India in 1793, and his translation of the New Testament into Bengali appeared in 1801. In the following years versions into other Indian languages were published; but in 1816 Carey found himself on the wrong tack and reported to his home correspondents as follows:—

"In the prosecution of it [sc. our object], we have found that our ideas relative to the number of languages which spring from the Sungskrit were far from being accurate. The fact is, that in this point of view, India is to this day almost an unexplored country. That eight or nine languages had sprung from that great philological root, the Sungskrit, we well knew. But we imagined that the Tamul, the Kurnata, the Telinga, the Guzrattee, the Orissa, the Sengalee, the Mahratta, the Punjabee, and the Sindoostanee, comprised nearly all the collateral branches springing from the Sungskrit language; and that all the rest were varieties of the Hindee, and some of them, indeed, little better than jargons capable of conveying ideas.

"But although we entered on our work with these ideas, we were ultimately constrained to relinguish them. First, one language was found to differ widely from the Hindee in point of termination, then another, and in so great a degree, that the idea of their being dialects of the Hindee seemed scarcely tenable. Yet, while they were found to possess terminations for the nouns and verbs distinct from the Hindee, they were found as complete as the Hindee itself; and we at length perceived, that we might, with as much propriety, term them dialects of the Mahratta or the Bengalee language, as of the Hindee. In fact, we have ascertained, that there are more than twenty languages, composed, it is true, of nearly the same words and all equally related to the common parent, the Sungskrit, but each possessing a distinct set of terminations, and, therefore, having equal claims to the title of distinct cognate languages. Among these we number the Juypore, the Bruj, the Ooduypore, the Bikaneer, the Mooltanee, the Marawar, the Maguda (or South Bahar), the Sindh, the Mythil, the Wuch, the Kutch, the Harutee, the Koshula, &c., languages, the very names of which have scarcely reached Europe, but which have been recognised as distinct languages by the natives of India almost from time immemorial.

"That these languages, though differing from each other only in terminations and a few of the words that they contain, can scarcely be called dialects, will appear, if we reflect, that there is in India no general language current, of which they can be supposed to be dialects. The Sungskrit, the parent of them all, is at present the current language of no country, though spoken by the learned nearly throughout India. It's grammatical apparatus, too, the most copious and complex perhaps on earth, is totally unlike any of its various branches. To term them dialects of the Hindee is preposterous, when some of them, in their terminations, approach nearer the Bengalee than the Hindee, while others approximate

more nearly to the Mahratta. The fact is, indeed, that the latest and most exact researches have shown that the Hindee has no country which can exclusively claim it as its own. Being the language of the Musulman courts and camps, it is spoken in those cities and towns which have been formerly, or are now, the seat of Musulman princes; and in general by those Musulmans who attend on the persons of European gentlemen in almost every part of India. Hence, it is the language which most Europeans get an idea of before any other, and which indeed, in many instances, terminates their philological researches. These circumstances have led to the supposition, that it is the language of the greater part of Hindoostan; while the fact is, that it is not always understood by the common people at a distance of only twenty miles from the towns in which it is spoken. These speak their own vernacular language, in Bengal the Bengalee, and in other countries that which is appropriately the language of the country, which may account for a circumstance well known to those gentlemen who fill the judicial department, namely, that the publishing of the Honourable Company's Regulations in Hindoostanee has been often objected to, on the ground that in that language they would be unintelligible to the bulk of the people in the various provinces of Hindoostan. Had this idea been followed up, it might have led to the knowledge of the fact, that each of these various provinces has a language of its own, most of them nearly alike in the bulk of their words, but differing so widely in the grammatical terminations, as, when spoken, to be scarcely intelligible to their next neighbours."

The report (which is signed by W. Carey, J. Marsham, and W. Ward) then goes on to give detailed proof of the foregoing remarks. Thirty-four specimens of thirty-three Indian languages are given. In each the specimen consists of the conjugated present and past tenses of the verb substantive, and of a version of the Lord's Prayer. Each specimen is taken up separately and, word by word, dissected, in order to show that it is not a specimen of a dialect, but of an independent language. The whole discussion is too long to quote, but it is very interesting reading, especially as it is the first attempt at a systematic survey of the languages of India. In this connection, it is well to remember that its date is 1816, and that its authors were Carey, Marshman, and Ward. The languages compared are as follows (I give the original spelling):—Sungskrit, Bengalee, Hindee, Kashmeera, Dogura (*i.e.*, Dogra), Wuch (*i.e.*, Lahnda), Sindh, Southern Sindh, Kutch, Goojuratee, Kunkuna, Punjabee or Shikh, Bikaneer, Marawar, Juya-poora, Ooduya-poora, Harutee, Maluwa, Bruj, Bundelkhund, Mahratta, Magudha, or South Bahar, North Koshula, Mythilee, Nepal, Assam, Orissa or Ootkul, Telinga, Kurnata, Pushtoo or Affghan, Bulochee, Khassee, Burman.

Carey's list well illustrates one point to which I have alluded in referring to Amaduzzi's list. To us no distinction appears to have been made between language and dialect. We find mentioned, great languages—like Burmese, Bengali, or Pashto—side by side with forms of speech like Jaipuri and Harauti, which are hardly separate dialects—certainly differing less than the dialect of Somerset differs from that of Devonshire. This is due to the fact that in at least Northern India, there is no word corresponding to our "language." All that the native Indian recognises is dialect. Unless taught on European methods, he has no word for denoting a group of cognate dialects under one general head. He has numerous (hundreds of) dialect names, just as we talk of the Somersetshire and Yorkshire dialects, but no word parallel to our general term, "English."

With Carey's report, further inquiry into the general relationship of the Aryan languages of India seems to have been dropped for a long period. The lately-formed Asiatic Society in Calcutta was too busy with the study of Sanskrit and Persian to trouble about the modern vernaculars. Practical grammars of the more important languages were, it is true, compiled in plenty, but there was at first no co-ordinated inquiry into the subject as a whole. On the other hand, the non-Aryan languages at once received the attention of a number of distinguished scholars. Space will not allow me to do more then mention the names of Francis Buchanan, the illustrious Leyden, and Nathan Brown, the missionary, who published comparative accounts of the Indo-Chinese languages in the first half of the nineteenth century. About the middle of the same century one name appears which overshadows all the rest—that of the great Brian Houghton Hodgson. He took up not only the Indo-Chinese languages, but also those of Dravidian and Munda stock, and his famous essays are still models of what such pioneer inquiries should be and storehouses of facts for those scholars who, less fortunately situated, are still endeavouring to unravel the complex knots of non-Aryan Indian philology. The earliest fruit of Hodgson's researches was Max Müller's letter to the Chevalier Bunsen, published in 1854, in which the Munda family of languages was first recognised as an independent body of speech

apart from the Dravidian, and given a name. Two years later, in 1856, appeared what has ever since been the foundation of all research into the tongues of Southern India, Bishop Caldwell's "Comparative Grammar of the Dravidian or South-Indian Family of Languages." Here for the first time a group of Indian languages was treated as a whole by a scholar who was practically familiar with its elements and at the same time a trained philologist.

As for the Indo-Chinese languages they also continued to receive study. The indefatigable Logan published essay after essay in the "Journal of the Indian Archipelago," in which the languages of Burma and Assam were compared and analysed. Logan wanted the philological training possessed by Caldwell, and hence his work has not retained the same authority as that of the great bishop, but he made many shrewd suggestions as to relationship between the languages he dealt with which have been confirmed, or rediscovered (for his papers are hardly known at the present day) by subsequent inquirers. After Logan's time not much was done in his domain for some thirty years. Forbes's posthumous "Comparative Grammar of the Languages of Further India" is but a tantalising fragment, and it fell to Professor Kuhn, of Munich, first (1889) to attack seriously one branch of the question and to put the philology of the languages of Further India upon a sound footing. His brilliant essay has been the starting point for a number of younger students who are writing at the present day.

Aryan languages remained untouched as a whole till 1872. John Beames, a young Indian civilian of barely ten years' service, had attracted attention in 1867 by the publication of a little summary of what was then known about all the languages of the country in his "Outlines of Indian Philology." Five years later appeared the first volume of his well-known "Comparative Grammar of the Aryan Languages of India." The same year witnessed the publication of Dr. Hoernle's first essays on the same subject, which were followed in 1880 by his "Grammar of Eastern Hindi compared with the other Gaudian Languages." These two excellent works, each a masterpiece in its own way, have since been the twin foundation of all researches into the origin and relationship of the languages of the Indo-Aryan family of speech.

All this time, for many decades, grammars and vocabularies of individual forms of Indian speech had been issuing in considerable numbers. For the better-known languages, such as Hindostani, Marathi, or Bengali, they came out in scores, and it must be confessed that most of them were labour wasted. Each writer copied his predecessor, corrected a few mistakes or not, according to his capacity, introduced a few more or not, and proclaimed a new gospel which was not new. Now and then a work of striking merit, such as Molesworth's Marathi Dictionary, Trumpp's Sindhi or Kellogg's Hindi Grammar appeared, but most of the rest were sorry stuff and were hardly wanted. The less-known languages, though equally important, were studiously left alone. Carey wrote his Punjabi Grammar in 1812; and it was forty years before any one again attempted to describe in a formal manner the language of the Sikhs. But, if this was the case with tongues whose speakers were numbered by millions, the state of affairs regarding the scores of minor languages spoken by thousands, the languages of the hill-tribes of Central India, of the Tibeto-Burmans of Eastern Bengal and Assam, was much worse. An enthusiast wrote a grammar or compiled a vocabulary here and there. Government encouraged its officers to make more, and a few did so—excellent works in their way. In 1874, Sir George Campbell printed a set of vocabularies compiled by local officials, but, with this exception, very little was done. Even with the help of foreigners the work hardly progressed. The first serious grammar of the language of Afghanistan was by a Russian—Dorn—and since his time, although numerous elementary grammars have been written by Englishmen, all the scientific study of this form of speech has been carried on by French or Germans. Similarly we owe the only existing grammar and vocabulary of the principal language of Nepal to the researches of a Russian. Examples of this kind might be multiplied, but, even with outside help, the total result was that our knowledge of these minor languages, a knowledge most important for the purposes of administration as well as in the interests of science, was scanty, unevenly distributed, and unequal. In fact, so late as the year 1878 no one had as yet made even a catalogue of all the languages spoken in India, and the estimates of their number varied between 50 or 60 and 250. Dr. Cust made a brave attempt to put together such an inventory in that year, but his "Modern Languages of the East Indies," in spite of all the industrious learning

and acumen of its author, was confessedly a compilation of existing materials, and those materials were equally confessedly imperfect. It was a tentative work, and was primarily intended to stimulate inquiry, not to close the subject.

Dr. Cust's work succeeded. It did stimulate inquiry. For the first time, Government, as well as European scholars, were enabled to see what little had been done and how much remained to be done. People talked about it and wrote about it, and, at length, in 1886, the Oriental Congress, then held in Vienna, in which Dr. Cust himself took a leading part, urged the Government to undertake "a deliberate systematic survey of the languages of India." The proposal was favourably received, but the carrying out of the scheme was delayed on financial grounds. In the year 1894 the matter came within the region of practical politics, and the preliminary details fell under discussion. The first question to be settled was the extent of the proposed survey. After consultation with the various local governments, it was decided to exclude the Provinces of Madras and Burma and the States of Hyderabad and Mysore from its operations, so that these would cover, from west to east, Baluchistan, the North - Western Frontier, Kashmir, the Punjab, the Bombay Presidency, Rajputana and Central India, the Central Provinces and Berar, the United Provinces of Agra and Oudh, Bengal and Assam, containing a population of about 224,000,000 out of the 294,000,000 of our Indian Empire.

Then, as to the nature of the Survey. After some discussion it was decided that it was primarily to be a collection of specimens, a standard passage was to be selected for purposes of comparison, and this was to be translated into every known dialect and sub-dialect spoken in the area covered by the operations. As this specimen would necessarily be in each case a translation and would, therefore, run the risk of being unidiomatic, a second specimen was also to be called for in each case, not a translation, but a piece of folklore or some other passage in narrative prose or verse, selected on the spot and taken down from the mouth of the speaker. Subsequently a third specimen was added to the scheme—a standard list of words and test sentences originally drawn up for the Bengal Asiatic Society by Sir George Campbell and already widely used in India. It was obviously desirable that, for purposes of comparison, this list should be retained in its entirety, and this was done, but a few extra words were added. The foundation of the Survey is thus these three specimens, the standard translation, the passage locally selected, and the list of words and sentences. It was then arranged that the first specimen should be a version of the parable of the Prodigal Son, with slight verbal alterations to avoid native prejudices, a passage which has been previously used and is admirably adapted to such a purpose.

This having been decided, I was entrusted with the task of collecting the specimens and editing them for the press. With this object the various local officers were instructed to render the necessary assistance, and I should be most ungrateful did I not cordially express my gratitude for the sympathetic and ungrudging help accorded by my brethren in the service of the Indian Governments and by many others, Europeans and natives, missionaries and laymen.

Before getting the specimens, we had to find out what it was that we wanted specimens of, and for this purpose the first thing to be done was to compile a list of all the varieties of speech then known to exist in the area under survey. Forms were sent out to each district officer and political agent with a request that he would fill in the name of every language spoken in his charge, together with the estimated number of speakers of each. The forms came back by degrees, and their contents, I must confess, rather appalled me. The total number of languages reported from the survey area was 231 and of dialects 774. Examination fortunately showed that some few names were returned over and over again from different provinces, and also that it was probable that in many cases the same form of speech was reported under different names. I may say that, so far as the process of elimination has gone, and it is now approaching completion, the number of languages spoken in the Indian Empire has been reduced to 147. No attempt has yet been made to count the actual dialects, but the total of these has also been considerably reduced.

The preparation of these lists was no easy mechanical process,—the sort of thing that could be done by an intelligent clerk. I pass over the difficulties encountered in compiling the local lists into general lists, one for each province. Those who have had experience in putting together hundreds of returns from different sources will know its laborious character, and those who have not can imagine it. But great difficulty was often experienced

in preparing the local returns which were the materials on which I had to work. Each officer knew about the main language of his district and, if he had been there some time, had probably a practical working acquaintance with it. But over and over again no one with any education knew anything about the little hole-in-the-corner forms of speech, which were discovered as soon as search was instituted. Let me give one example. In one of the Himalayan districts, of which the main language was Aryan, a small colony was discovered which originally hailed from Tibet and which retained its own language. No official knew it, and intercourse with them was conducted by means of a *lingua franca*. Well, the district officer reported to me the name of the language. I have forgotten what it was, but it was not one word or two words. It was a solemn procession of weird monosyllables wandering right across a page. I could make nothing of it, nor could my Tibetan-knowing friends. Remember, it was a foreign expression written down in English letters as it sounded to the ear of a person entirely unacquainted with it. All my endeavours to identify the name failed. At last I wrote to the district officer and asked him to make further inquiries. In reply, I got a letter full of apologies. It was explained that investigation had shown that the monosyllabic procession was not the name of a language, but was the local method of expressing "I don't understand what you are driving at." This is a new version of the old Anglo-Indian Joe Millerism concerning the young civilian who went out for his first ride in the country and was much puzzled by the fact that all the villages through which he cantered had the same name; and it has the advantage of being true. The common name of all the young civilian's villages was "Ma'lum nahin," which is being interpreted, "I don't know." I may add that the puzzling Himalayan dialect ultimately turned out to be a corrupt form of Tibetan.

Another difficulty was the finding of the local name of a dialect. Just as M. Jourdain did not know that he had been speaking prose all his life, so the average native villager does not know that he has been speaking anything with a name attached to it. Every native can put a name to the dialect spoken by somebody fifty miles off, but—as for his own dialect—"O, that has no name. It is simply the correct language." It thus happens that most dialect names are not those given by the speakers, but those given by their neighbours, and are not always complimentary. For instance, there is a well-known form of speech in the south of the Punjab called "Jangali," from its being spoken in the "Jungle" or unirrigated country bordering on Bikaner. Now "Jangali" also means "boorish," and the local inquiries failed to find a single person who admitted that he spoke that language. "O, yes, we know Jangali very well—you will find it a little further on—not here." You go a little further on, and get the same reply, and pursue your will-o'-the-wisp till he lands you in the desert, where there is no one to speak any language at all. These illustrations show the difficulties encountered by the local officers in identifying dialects and naming them.

From the local lists received, as described above, provincial lists were compiled by me and printed. These did not profess to be accurate catalogues of the tongues of India. They only claimed to represent the then existing knowledge of the state of affairs as reported by officers with local experience, who did not pretend to be philological experts. As such, they formed the basis of the survey operations. When the lists were printed, the various dialects were divided into two main classes distinguished by different type, viz. (1) those which were vernaculars of the localities from which they were reported, and (2) those which were spoken by foreigners. The latter were once for all excluded, and attention was henceforth devoted to the former.

Each district officer was now asked to provide a set of the three specimens of each language locally vernacular in his district. Careful instructions were given for the preparation of these specimens. It will be remembered that the first was to be a translation of the parable of the Prodigal Son. It was recognised that in many, nay, in most cases, the translators would not know English, and, in order to assist them a volume of all the known versions of the parable in Indian languages was compiled with the help of the British and Foreign Bible Society, of local missionaries, and of one or two Government officers who were specially interested in the survey. This collection, which was published in 1897, under the name of "Specimen Translations in various Indian Languages," contained sixty-five versions, and, though primarily intended as a mere tool to aid the execution of the scheme, aroused some temporary interest among scholars in Europe. For the

survey, it was anticipated that whoever might have to prepare a specimen, even if he did not know English, would find in this book at least one version from which he could make a translation; and this, in fact, was borne out by subsequent experience.

The second specimen, which was to be locally selected, presented no similar difficulties, but instructions were given that all specimens were to be written (*a*) in the vernacular character (if there was one) and (*b*) in the Roman character with a word for word interlinear translation. The second specimen was also to be furnished with a free translation into good English. As to the style of translation, local officers were told that the language of literature was always to be avoided. What was to be aimed at was the acquisition of specimens in the home language of each translator, whether it was looked upon as a vulgar patois or not. For the third specimen, the list of standard words and sentences, blank books of forms were supplied, which only needed to be filled up.

As each provincial list of languages was completed, the circulars calling for specimens were issued. The latter began to arrive in 1897, and continued to do so up to about the end of 1900. Since then, to a few months ago, stray belated examples have kept dropping in at irregular intervals, but the collection may now be taken as complete.

The editing and collating of the specimens commenced in 1898, and has continued ever since. The first rough work was done in India, but in 1899 I returned to England, and since then the work has been carried on in this country with the efficient aid of my assistant, Dr. Konow, of Christiania.

The editing of the specimens has been no light task. Before anything could be printed, a general scheme of classification had to be decided upon, and that on a very imperfect knowledge of the materials. As the work went on discoveries were made which rendered necessary a revision of the classification; and sometimes these were made too late, so that the materials have not always been arranged as, with further knowledge, I should like them to be arranged now. This was especially the case in regard to the Indo-Chinese languages, in which my assistant and myself were walking on ground which hitherto had often been untrodden, and had to deal with languages for which no grammars or dictionaries existed. Here mistakes of classification were inevitable, but I am glad to be able to think that none of first class importance were made, and that, on the whole, though I might now group a few individual languages differently from the manner in which they have been grouped in the published volumes of the Survey, my present knowledge would not lead me to make any substantial alteration.

I have never counted the total number of specimens received. They amount to several thousands, and it stands to reason that it was not possible to print all of them. The surplusage was deliberately estimated for. It was calculated that the specimens would vary in value. Several would be received of each dialect. Some would be prepared carefully, others ignorantly, others carelessly. Many of them would come from the mouths of uneducated people, hardly able to grasp the idea of what was required. A mass from which to select was, therefore, a desideratum, and this, in most cases, was secured. It is only in the case of a few less-known dialects of the Himalayas and of the Assam frontier that single specimens were obtained. These were, in all cases, forms of speech which had never been recorded in writing before, and mistakes in recording them were to be expected. Thanks to the constant sympathy and ungrudging aid given by our frontier officers, the most enthusiastic among my helpers, many doubtful points were cleared up by correspondence, and I hope that in after years it will be found that these specimens are not very wrong. Absolutely accurate we cannot expect them to be. To give an idea of the difficulties experienced, I may mention that the correction of one specimen was delayed for over six months by a fall of snow in the Hindu Kush, which prevented the Political Agent at Chitral obtaining the services of the only available bilingual speaker of one of the Pamir dialects. Again, in the case of one of the Kafir languages of the Hindu Kush, no one who spoke it could at first be found. At length, after a long search, a shepherd of the desired nationality was enticed from his native fastnesses to Chitral. He was exceptionally stupid, probably very much frightened, and knew only his native language. A Bashgali Shekh was found who knew a little of it, and who also knew Chitrali. With his aid the translation of the parable was made through Bashgali and Chitrali. Much accuracy could not be expected from the result; but with care and the assistance of the local officers, a version was ultimately made, which (though it contains some passages that I have been unable to analyse completely)

has very satisfactorily complied with the somewhat stringent philological tests to which it has been subjected.

This was by no means an isolated example. There were scores of languages, for which no one could be found who knew any one of them and at the same time English. People would think, for instance, that our officials would be familiar with most of the languages spoken in the neighbourhood of the port of Chittagong. Yet there is an instance on record of a criminal case which was tried in the Chittagong Hill tracts. One of the witnesses was a woman who knew only the Khami language. This was translated into Mru, which was then translated into Arakanese, which was again translated into the local dialect of Bengali, from which version the magistrate recorded the quadruply refracted evidence into English. This makes no reflection on the officer concerned. There are parts of India which seem to have had a special Tower of Babel of their own. From the little province of Assam, for example, with its population of only about six millions—say the same as that of London—ninety-six Indian languages were returned at the last census. Mezzofanti himself, who spoke fifty-eight languages, would have been puzzled here.

As each dialect was examined, a specimen or specimens of it were selected for publication and made ready for press. From the specimens a sketch of the grammatical and other peculiarities was prepared, and reference was made to any points worth noting about the speakers. Dialects were then grouped into languages, and for each language a somewhat elaborate introduction was provided, sketching the habitat and number of speakers; distinguishing the dialects and comparing their characteristics; giving, when known, the ancient history of the language, and locating its relationship to others of the same family; describing briefly the salient points of the literature, when there was one; supplying a bibliography as full as we were able to make it; and concluding with a sketch of the grammar.

As volumes became ready, they have been printed and published. The following is a list of those which have been issued up to the present date:—The Mon-Khmer and Tai languages; two volumes dealing with Tibeto-Burman languages; two volumes dealing with Bengali, Assamese, Bihari and Oriya; one volume dealing with Eastern Hindi.

The volumes dealing with Marathi, Rajasthani, Gujarati, the Munda, the Dravidian, and the remaining Tibeto-Burman languages are in the press; those for Western Hindi, Panjabi, and several minor languages, are ready for the printer, and practically all that remains to be done are the sections dealing with Sindhi, Kashmiri, and some of the Aryan languages of the Himalayas. We may thus say that the Survey is within a measurable distance of completion.

Throughout the whole series of operations one thing has been steadily borne in mind—that the results were not to be bundles of theories, but collections of facts. The languages had to be arranged in some order or other, and this necessitated grouping, and grouping necessitated the adoption of theories as to relationship. So much could not be helped; but, beyond this, every effort has been made to prevent the Survey becoming an encyclopædia of Indian philological science. That will, we may hope, follow when scholars more competent than the present speaker have had time to digest the immense mass of ordered facts laid before them. Indeed, this has already commenced. Pater W. Schmidt, of Vienna, the great authority on the languages of Further India, has analysed the materials laid before him in the Indo-Chinese sections of the Survey, and has published two important works dealing with the Mon-Khmer languages. He has been able to show that in former times there must once have been a very widely extended language, which was the parent, not only of the Munda tongues of Central India, but also of the Khasi language of Assam, of the speech of the Nicobar Islands, of the Mon of Pegu, and numerous other languages spoken round the Gulf of Siam, including that of the Urang Utangs (who are men, not monkeys) of the Malay Peninsula, and even of some of the Oceanic languages of Australonesia.

In the year 1892, Professor Thomsen, of Copenhagen, had maintained that there was a relationship between the Indian Munda languages and those of certain savage tribes in Australia. The theory did not then commend itself to all scholars, as it was considered that the grounds were not sufficient. The further materials now given by the survey have enabled Pater Schmidt to carry on this investigation much further, and I hope that we may soon expect a work from his pen which will set the matter beyond doubt, so far as the present generation is concerned. But there is still another surprise. The languages spoken in the Himalayas, far to the north of the Munda

languages are, it is well-known, Tibeto-Burman in character. But even here there is a line of peculiar forms of speech, extending from the Punjab to Darjiling, which show evident traces of this same old language, which has been, so to speak, overlaid by the Tibeto-Burman of the later immigrants. There is thus evidence to show the existence, at some very ancient time, of a common language, of which traces now exist, from Kanawar in the Punjab down through Further India into Oceania and Australia. Philology is not to be confounded with ethnology, and here we may leave these interesting facts in the hands of ethnologists for further examination.

Time will not allow me to give more than a very brief outline of what has been done by the Survey for each of the great families of Indian languages. Let us take the Aryan languages—the latest comers—first. We know that the speakers entered India from the North-West, probably by the valley of the Kabul. The immigration was, we also know, a long affair. We have ancient songs of this period, celebrating then living kings, and we have later songs of the same period which tell of the same kings as deified heroes. The two documents must have been separated by centuries, so that the settlement of the Aryans in the Punjab must have been very gradual. Horde after horde entered, and, as might be expected, the latest comers spoke an Aryan language different from that of their earliest predecessors. We find one set calling another "unintelligible" and "barbarous," with all the freedom of speech usual among near relations. There are, in the Vedas, actually hymns to be used at the initiation into civilised society of Aryans who have hitherto not conformed, and who speak a dialectic language. The Survey, in classifying the modern Aryan vernaculars of India, shows that these reflect the same state of affairs. There is a central language spoken in the Gangetic Doab, the parent of the great *lingua franca* of India, Hindostani, and descended from the old dialect which is still preserved in a literary form under the name of Sanskrit. This has certain well-defined characteristics, the most noteworthy of which is the ease with which it has abandoned inflexion and has become, like English, a great means of general intercourse. Round it, almost in a complete circle, there is a different set of languages, agreeing amongst themselves in everything in which they differ from the central language, and especially in the tendency which they exhibit, so far from abandoning inflexions, of creating new inflexions when old ones have become worn away. There is as great a difference in grammatical structure between the inner language and those of the outer circle as there is between English and Latin. Between the two there is an intermediate band in which the characteristics of the two sets of languages are mixed in varying degrees. One of these intermediate tongues is Eastern Hindi, hardly known to any European scholars, and yet the great literary language of modern India. The central language has created the Indian *lingua franca*, while an intermediate one is the vehicle of all the best heroic poetry.

Beside the Aryans who entered India by the Kabul valley, a small independent immigration came into the Western Punjab over the Hindu Kush. Most of them settled in the country round Gilgit, Kashmir, and Chitral, and in Kafiristan. They have lately been identified with the Pisachas or "eaters of raw flesh," who in later ages became the subject of legend, and were looked upon in Sanskrit times as a race of demons. The inhospitable character of the mountains in which they settled, and their own savage nature, which is preserved in Kafiristan to the present day, has hindered communication with their cousins of the plains. Their language has thus been kept apart and has developed on its own lines. At the present day it still possesses a very archaic character. Words which were used three thousand years ago in the Vedas and which have since fallen into disuse in India proper, have been preserved almost letter for letter. Very little was known about these languages (though we have had brief accounts of some of them from the pens of General Biddulph and Dr. Leitner) till the Survey took them up. We have now short grammars and vocabularies of all but two.

Ethnologists have borrowed the word "Dravidian" from us language-people, and have given it a different meaning, which causes some confusion. To an ethnologist the word connotes a certain type of men inhabiting the centre and south of India. These ethnological Dravidians do not all speak languages belonging to the same family. Some of them speak languages which I call Munda, and others speak languages which I call Dravidian. What is worse is that there are speakers of Dravidian languages who are not members of the so-called Dravidian ethnic stock. If I may venture to tread on treacherous ashes

covering hidden fires, I would suggest that the aboriginal inhabitants of this part of India spoke a language of the Munda class, and that their ethnic type was that which ethnologists called Dravidian, but which should really be called Munda. It may then be suggested that Dravidians, possessing a different ethnic type, entered India from the south or from the north-west, and conquered the Mundas, with whom they intermarried, and whose ethnic type they gradually assumed, while they preserved their own form of speech. This is what certainly has occurred in the case of the Aryan invaders of India, who have preserved their speech, but exchanged their ethnic type for that of their neighbours among whom they settled, and there is no reason why the same should not have been the case with the Dravidians.

As for the Munda languages, the Survey has succeeded in striking off the names of several. Grammars have been prepared for the minor forms of speech, and for the first time all these have been looked at as a whole. We are now able to say that no less than nine of these so-called languages (including the well-known Santali and Mundari) are really slightly varying dialects of one important language, spoken by more than two and three-quarter millions of people, to which we have, in English, given the name used by the people themselves, viz., "Kherwari."

Those who are not familiar with the subject would be filled with amazement at the wonderful complexity, and yet regularity, of a pure Munda language. How our schoolboys would envy those who were taught a language to which the terms "masculine," "feminine," and "neuter" are unknown; which has only one declension of nouns, and that with no exceptional forms; which has only one conjugation, and no irregular verbs. Nay more, every word in the language can be changed into a verb by simply adding the letter "a." Contemporarily with the *entente cordiale*, our brothers across the channel have, I believe, invented the verb "five-o'clocker," meaning "to have afternoon tea." In Kherwari, such a formation would be perfectly usual and regular. And yet, in spite of all this, the Munda verb is one of the most complicated structures imaginable. Every idea can be expressed in it by a separate syllable tacked on to the main root. As Max Müller said of the very similar Turkish language, we might imagine it to be the result of the deliberations of some eminent society of learned men; but no such society could have devised what the mind of man produced, left to itself in the hills of Central India and guided only by its innate laws, or by an instinctive power as wonderful as any within the realms of nature. Let me give you one example. The word *dal* means "beat." Now, if my slave's son was too often getting himself entangled in shindies, I should have to employ the following verbal form, which is not a sentence, but is one word, *da-p-al-ocho-akan-tahen-tae-tin-a-e*, which means "he who belongs to him who belongs to me will continue letting himself be caused to fight." Remember that (with one or two exceptions) none of this catalogue of suffixes has any meaning as an independent word, but each gives its own quota to the general sense of the whole compound. You will now underhow the conjugation of the Kherwari verb occupies for one person alone nearly a hundred pages of the standard grammar of the language.

In spite of what has been urged by previous scholars, the Survey has clearly shown that the Dravidian have no connection with the Munda languages. They differ in pronunciation, in their modes of indicating gender, in the declension of nouns, in the method of indicating the relationship of the verb to its objects, in their numeral systems, in their principles of conjugation, in the methods of indicating the negative, and in their vocabularies. The few points in which they agree are such as are common to many languages scattered all over the world.

The Survey has done little for the great literary languages of Southern India, as these fall outside the area of its operations: but all the minor dialects, the tongues of the Gonds of Central India, of the Khonds, famous for their old-time human sacrifices, and of other hill tribes further north, have been examined, classified, and compared. Where necessary, grammars and vocabularies have also been been compiled.

It is in regard to the Indo-Chinese languages of Northern and Eastern India that the Survey has broken most new ground. We examined 132 of these, many of which, being spoken in Nepal, are not included in the 147 forms of speech vernacular to British India. We found ready at our hand grammars and vocabularies of perhaps a score of them. For the rest we had little help from our predecessors. Here it was that we owed most to individual local officers and missionaries, who spared no labour in procuring specimens and information,

and in solving difficult points. It must be remembered that many of these languages had never been put into writing before. Some of them were spoken by wild tribes only lately brought under the restraining influence of the *pax Britannica*, and whose one idea of conversation with a stranger in past years had been to cut off his head. Such people are not good subjects for healthy philological inquiries, nor did those Englishmen who came into contact with them profess in all cases to be expert philologists. I am, therefore, all the more grateful for the enthusiasm exhibited by my kind correspondents, and for the pains taken to secure accurately translated specimens. From these we have been able to prepare short grammars and vocabularies illustrating the main peculiarities of each form of speech.

I think that it may be accepted that, so far as India, nearer and further, is concerned, the original home of the speakers of these Indo-Chinese languages was the head-waters of the Yang-tse-kiang. From here they migrated in successive waves down the valleys of the great rivers of Eastern India, the Me-kong, the Irrawaddy, the Chindwin, and the Brahmaputra. The earliest immigrants, if they were not the original inhabitants of the country, were the Mon-Khmers. I have already mentioned how their language must once have extended over Central India, and that traces of it are found in the Punjab Himalayas and in Australonesia. Its principal representatives at the present day are the Khasi of Central Assam, and the Mon or Talaing of Pegu. Other important languages, such as Khmer, are found in Cochin China, while a number of petty tongues of the same family are found in the hills on both sides of the Me-kong.

The next, or perhaps the first, invasion was that of the Tibeto-Burmans, who drove the Mon-Khmers up the hills or down to the sea coast, and occupied the level country and what parts of the hills they could get hold of. They thus filled the river valleys of Burma and Assam as well as the intervening hills. Some of them went up the Brahmaputra into Tibet, which they peopled, getting as far as Baltistan and Ladakh, and also occupying the Himalayas between Tibet and India proper.

The next immigration was that of the Tais. In the sixth century A.D., these settled, as Shans, in Eastern Burma, and thence spread into Siam, driving their predecessors, the Mon-Khmers into the hills or down to the sea-coast. They also worked northwards, up the Irrawaddy and Chindwin, into Assam, which they conquered in A.D. 1228. These last Tais were called Ahoms, and the name "Assam" is said to be a corruption of this word. There are still Tai-speaking colonies in the country, but the hills were already occupied by Tibeto-Burmans and Khasis, and the Ahom language had to contend with the more powerful Aryan language, Assamese, which came from the west. It, therefore, never became the national speech.

All the Indo-Chinese languages are monosyllabic. Each primitive word consists of but one syllable, and refuses to be classed under any of the well-known categories of noun, verb, and particle. It connotes an indefinite idea, which may be employed to express any part of speech, according to its position in the sentence or its relation to its neighbours. The words being monosyllables, the necessary paucity of sounds is eked out by tones, each sound being raised or lowered in pitch, shortened or prolonged, according to the idea which it is intended to convey. For instance, the Shan monosyllable *kau* means "I," "be old," "nine," "a lock of hair," "indifference to an evil spirit," "an owl," "a *butea* tree," "complaining of anything," "the shin," "the balsam plant," or "a mill," according to the tone with which it is pronounced. An example made classic by Max Müller is the Annamese word, *ba*. With the ordinary tone it means "three," with a grave tone it means "a lady," with a sharp tone "the favourite of a prince," and with the ascending tone it means "a box on the ear;" so that *ba bà bá bả*, if pronounced properly, means "three ladies gave a box on the ear to the favourite of the prince." The number of tones differs in the various languages. Shan has fifteen, while Western Tibetan is said to have only one.

The most characteristic of these languages, Chinese and Tai, belong to what is known as the isolating class, *i.e.*, every monosyllable has a distinct, definite meaning of its own, and complex ideas are expressed by compounding two or more together. For instance, "he went" would be indicated by three words, one meaning "he," another connoting the idea of "going," and a third connoting the idea of "completion." The Tibeto-Burman languages, on the other hand, chiefly belong to what is called the agglutinating class, in which certain words are now only used as suffixes to indicate relationship in time or space, and cannot be employed indepen-

dently with meanings of their own. It is as if the word "completion" in "he-going-completion" had lost its original meaning, and was now only used as a sign to indicate that the idea connoted by some other word performing the function of a verb was also the idea of a completed action.

It is unnecessary to dwell on the practical side of the Linguistic Survey, or on the help which it is likely to afford to sympathetic administration. The long list of languages, described and furnished for the first time with elementary grammars and vocabularies, speaks for itself. Nor need I do more than remind you of the gain which we may hope will accrue to the science of language from the new materials now placed at its disposal. But one aspect of the subject may perhaps be dwelt upon in a few sentences. I trust that it will do good by drawing attention to the fact that many of these languages have literatures —aye, great literatures. India has a glorious literary past, and is paying dearly for it. Europe, fascinated by the glamour of the wonderful variety of Sanskrit literature,—blinded by excess of light,—has hitherto refused to look beyond that noble language. In India, Sanskrit was discovered to be a dead language a thousand years ago, and writers then began to speak to the nations in their own tongues. But the nations were the same as in past ages, the land was the same, the surroundings were the same, the inspiration was the same. Though Sanskrit ceased to exist as aught but a school-language, literature,—poetry, romance, science,—still continued, while the nations themselves went on. There has been a steady development, and India is not what it was ten centuries ago. A mighty wave of spiritual revolution has swept across its face, obscuring the memory of the old deities and of their worship, and profoundly affecting the thoughts, the morals, the customs of the country. All this, and the splendid literature created by it, is unknown to those whose studies begin and end with Sanskrit, and yet it is they who teach England about India. If the Survey will only induce scholars of the West to examine the literatures of the great modern vernaculars,—no mean heritage of no mean land,—it will by that alone have done much to increase the sympathy between us and our great Eastern Empire.

A bye-product of the Survey demands more than a passing notice. It will be remembered that it was suggested that the second specimen of each dialect should be a piece of folk-lore. That suggestion was widely adopted, and the volumes of the Survey will be found to contain scores of popular tales, many of which have hitherto never been published, and which have interesting parallels in the popular literature of other nations. Again, the mere act of translating sometimes throws sidelights on the customs and morals of savage tribes. Thus, there are some tribes whose only idea of general rejoicing is getting intoxicated on their native beer. They do not seem to have a word for feasting which does not also connote the idea of drunkenness. This came out in the version of the parable, when an attempt was made to translate the passage about the rejoicing over the returned prodigal. Again, the wild Sema Nagas, one of the most savage and barbarous tribes in Eastern India, have contributed an example of dramatic literature in its most rudimentary form, in which the tribal view of the marriage state is put forth with a simplicity and directness which only permit of partial publication.

As a specimen of folklore, let me give you a version of the Swan-maiden legend, which came from another wild tribe akin to the Semas:—

"The villagers would not let Jessu's motherless children draw water from the well, so he dug a new one for them, but the water they brought was always muddy. So he went himself and found the water in the well as dirty as what they brought. Taking his shield and spear he watched. As he sat there three goddesses came down and drew water. There was a big stone at the edge of the well. On it they put down their head-bands and began to bathe. While they frolicked Jessu stole one of the head-bands and sat upon it. When they had finished their sport the goddesses picked up each her head-band and flew away, but she whose head-band Jessu had stolen could not accompany her sisters. So Jessu seized her and would not restore it to her till she had promised to be his wife. To this she consented, and he took her home and they lived happy ever afterwards."

Here is a quaint story from the Pamirs which is new to me, though some of those present may have met it in the course of their reading:—

"The mosquitos have a lawsuit before Solomon the Prophet against the wind. They complain that the wind will never let them stay where they want to stay. Solomon commanded his Vizier Asaf to summon the wind, but when the wind arrived the mosquitos had to leave the court. As the plaintiffs and the defendant can never be brought together before the judgment-seat the case has never been decided and is still pending."

Finally, let me give you a pretty piece of eschatology from the Kabui Nagas :—

"We human beings can after death reach the holy feet of God in heaven, if we do not commit any sin and pass our lives honestly in the world; but those who commit theft and tell lies or cheat are all sent to hell. When a suckling child dies, it lies wailing at God's feet, because it is hungry and longs to nestle in its mother's bosom. When its mother dies it says to God, 'O God, is my mother dead? Let me see her, and from her bosom let me quench my thirst.' But God answers, 'Child, your mother cannot now come here, for she is in hell, bound with fetters for committing theft when she was alive.' Nevertheless the child continues to wail bitterly, and makes repeated prayers for the release of its mother. At last, God, the Compassionate, releases the mother from hell, and brings her to the thirsty child, who is now made happy to its heart's content."

Scores of such interesting tales appear in the pages of the Survey.

I have now traced the Linguistic Survey of India from its inception to its present stage of existence. So far as the volumes have been published they have been favourably received by those well qualified to judge, and this verdict is a fitting response to the traditional liberality of the Government of India. If it had not been that the learned world had previous experience of that Government's liberality in the cause of science, the scheme would never have been suggested, and without that liberality it could never have been undertaken or carried through. To Dr. Konow, my valued assistant, and myself, the Survey has been one long romance. It is true that we have endeavoured to be veritable Gradgrinds in recording facts and facts alone. But what facts! On every page we seemed to hear, re-echoing down the corridors of time, inarticulate murmurs of the past, when China was pre-Chinese, when our ancestors herded their flocks on the borders of the Caspian, and, perchance, when rude armies were invading India from that mysterious Lemurian Continent over which now roll the heaving waters of the Indian Ocean. What food for imagination was here! What history lies hidden in this apparently dry grubbing amongst roots and fossils! And then, coming to the modern times, there was the ever-present contrast between the wild and the civilised. Wearied, perhaps, with the analysis of some savage dialect possessing but a few hundred words, one could turn to the plains of India with their splendid modern literatures, and recognise that here is an enchanted garden, its paths almost untrodden by explorers from the West—a garden not formal — not made by rule or governed by precept like its wonderful Sanskrit predecessor, but one in which Nature, suffused with bounteous sunshine, affords vistas of never-ending delight; its forest trees, high in their nobility, bending under the weight of flowers of thought illumined by a delicate fancy. I would say now, as I have said before, that if these poor words of mine can entice my friends to enter that enchanted garden, I know full well that they will not leave it again without regrets, and the Linguistic Survey of India will have performed one at least of the objects for which it was projected.

DISCUSSION.

The CHAIRMAN said—I think you will all agree that we have listened to a most interesting paper, dealing with a subject of national importance for India and England, and set forth in masterly outlines so far as the limits of time permitted. I have already mentioned the recognition which the volumes of the Survey have met with abroad—one of the most interesting being the award to Dr. Grierson last year of the Volney Prize by the French Academy; and I may, perhaps, add that in 1902, at the Oriental Congress held at Hamburg, I found that the Italian Government were so struck by the excellence of the plan adopted by Dr. Grierson that they proposed to carry out a survey of the languages of that kingdom upon practically the same lines as those which he laid down. I think that two reflections naturally occurred to us as we listened to the paper. The first was one of satisfaction that a Briton—or perhaps I should say an Irishman—should have succeeded in carrying out so great a work, of a nature which is more familiar to Continental scholars than to natives of these islands. Certainly there are not wanting great names in Oriental research among subjects of the British Crown. I need only mention Sir William Jones, Henry Thomas Colebrooke, James Prinsep, Horace Hayman Wilson, Edward Cowell, Edward William Lane, Henry Rawlinson, William Wright, and Robertson Smith, among those who have passed away, who by common consent have in their time been equal to any whom the Continent could produce. Others have been mentioned by Dr. Grierson. And here I should like to say with how much regret we and all his friends have seen the announcement in to-day's *Times* of the death of Cecil Bendall, who was Cowell's successor in the chair of Sanskrit at Cambridge. Professor Bendall was not only a most learned Sanskrit scholar: he had on two occasions visited India, and made a somewhat long stay in that little-known kingdom of Nepal, where libraries of ancient manuscripts survive, which are much older than anything to be found in the plains of India, and where, as you

know, the Buddhist religion occupies the only area of Indian soil of which it still holds possession—the poor remnant of its vast dominion under Asoka and his successors. Much was done by Professor Bendall to bring these treasures to the knowledge of scholars. But it must be confessed that our roll of Oriental scholars is very short when compared with that of Germany or France, and that, considering the extent of the British Empire in the East, it is a national reproach to us that we have not done more to advance the knowledge of the world in regard to the languages and ethnology of that Empire. The Government of India has not been backward in encouraging and supporting such endeavours when they have been made; and we may hope that Dr. Grierson's labours as a pioneer will find many imitators in our Indian services, and will stimulate them to do what lies in them to take away this reproach from us. The other reflection is, I think, the immense importance, from a political point of view, of spreading among our administrative services, and especially the civil and educational services, an intimate knowledge of the languages and vernacular literatures of India. Sometimes one finds in India a tendency to depreciate studies of this kind, and a disposition to think that labour spent upon them is of little use in what is called the practical work of administration. I have heard officers who occupied themselves with them slightingly spoken of as "Pandits" or "Maulavis." But that is our English way. In most public schools, as we know very well, the general opinion of schoolboys looks upon any one who takes more than the minimum amount of trouble with his studies as an undesirable person, and invents a number of opprobrious names for him. I have had a somewhat long experience of service in India, and I say confidently that I have never known an officer the worse as a worker for knowing more than others of the language and ideas of the people. There may have been one or two who, for the sake of the money rewards which the Government offers for passing examinations in Oriental languages, gave to these studies time which should have been devoted to their official work. But evidently that is not to be put down to the discredit of the studies themselves. On the other hand, I have known many whose efficiency and influence were increased by the knowledge they possessed of the minds and ideals of the people, which can only be learned by a study of their language and literature. I will mention only two cases, both of men now dead, which will, I think, be generally recognised by those who knew them as conclusive. The first is that of Sir William Muir, whose long and most distinguished career closed last July. I had the privilege of serving under him in the North-West Provinces at the commencement of my service in India, and well remember the high and general respect in which he was held by Indians for his great knowledge of Arabic and his complete mastery of the vernacular. At the same time he was recognised by the Government as the greatest authority of his day in revenue administration, and his Lieutenant-Governorship was one of the most distinguished in the records of the Indian Empire. The other is that of Robert Blair McCabe, the tamer and civiliser of the Angami Nagas, who was killed in the Assam earthquake of June 1897. The mastery that McCabe acquired over the splendid savages he was sent to rule was due in great part to the intimate knowledge which he had of their language, of which he wrote the first grammar and phrase book. Nothing could be more admirable than to listen to his talk with them over a camp fire, when I was in the hills with him in 1888. They spoke their minds to him freely, knowing that they would be understood, and were on the most brotherly terms with him. Certainly no officer could have established such relations with them, or could have accomplished the work which he achieved, without the knowledge which he possessed. I am convinced that we want more and more of such knowledge in our dealings with India, and that it is of the highest political importance to develop and extend it. The alternative is not pleasant to contemplate. If our officers do not learn the languages and read the literatures of the people, they must depend upon the representations of the wants and wishes of the people as expressed and interpreted by the small minority who use English. I am the last to undervalue the great progress which has been made in the last twenty years in the spread of English education in India; and we all of us know what a wonderful mastery of our language, both in speaking and writing, many Indians have acquired. With that mastery, they have also assimilated our ideas, our ways of speaking and thinking, till we are tempted to imagine that, after all, India is very like England in most things. Certainly there are many things common to human nature, both in England and India; but there are also many things in which India is very unlike England, and these are things which it greatly concerns us, both for the good of the people and for the security of the Empire, to know. And to such knowledge the only adequate key is a thorough acquaintance with the popular speech, and with the minds of the people as exhibited in their spontaneous and indigenous literature.

Colonel Sir RICHARD TEMPLE, Bart., C.I.E., congratulated the author on seeing the end of his labours in view, and also, as evidenced by the paper, his very obvious qualifications for the task he had undertaken. The audience had been treated to a story of carefully organised preparation in enquiry which showed great qualifications for the task; to a story of patience in sifting evidence and of organised collocation of results; and, lastly, but by no means the least, to rapid publication; so that they had now before them a practical, general survey of the people who spoke the languages and dialects classified with practical, and not theoretical, knowledge, also their

history, their place in philology, their bibliography, and their grammar explained in a practical manner. To his mind those were very great achievements, and of value alike to the administrator and to the philologist. Some results had been already visible, even before the volumes were completed, because they were already learning as a fact what some had long suspected, namely, the widespread nature of the obscure Mon-Khmer group of languages. That was especially interesting, because the fact was strongly doubted less than fifteen years ago by the leaders of philology. Another point which was of very great interest to him personally was the definite allocation of the Nicobarese language, because with some others he had broken his head for several years in trying to learn the details of that most difficult tongue. The author's survey was also of value to history, as showing the lines of immigration by the *débris* left behind in linguistics; and he had also done a real service in proclaiming that philology was not ethnology, though both were sister studies and mutually helpful; and in showing especially that in the term Dravidian there had been a great danger in borrowing a term from philology for use in ethnology, and *vice-versa*. That was a most unfortunate habit, and had led perhaps to more muddle-headed science than anything which had ever been done. He was glad that the author pointed out, by description, that the Munda language had developed on simple scientific principles, and also incidentally, how uncommonly difficult simple scientific principles could be to any foreigner trying to learn the language to which they had been applied. Dr. Grierson had given an example of that fact in the very long-winded expansion of the root *dal*, which was itself not a long one, and which had been expanded into about twelve or thirteen syllables in one of the words. From his own experience in trying to learn a similar language, the Nicobarese, he had managed to unearth in what part of the dozen syllables the root *dal* came in, and he found it in the beginning in *da-pal*. That was the result of what are called infixes; and although infixed affixes were a very simple device on paper, they were most exasperating to anybody who tried to find them out. He was particularly grateful to the author for tracing the Indo-Chinese people home, because all the Mon-Khmer traditions and linguistic remains that he had come across tended to show a driving of the people down the great rivers to the coast, and from the author's paper that was now known to be a real fact, with the exception of the linguistic derelicts in the hills. He doubted, however, whether the Mon-Khmer were really the aborigines of what was now the Indo-Chinese country, and thought it was much more probable that the aborigines were Negritos, such as were now found in the Andamans and in the Malay Peninsula and Archipelago. He would like to ask Dr. Grierson one question with regard to the Indo-Chinese, namely, whether his researches had proved what he (Sir Richard) had been so long preaching, that tones in the monosyllabic languages supplied the place of inflection in what were called the Aryan languages? Another point which the author had brought out was the splendid literature which was locked up in the Indian languages, and the very great literary value of the songs and tales of the people. Dr. Grierson had truly said that Indian literature was far from confined to Sanskrit and Pali as the Pundits would have them learn. They could not too strongly impress upon European scholars and the reading public the great value of the work of the eclectic mediæval Indian reformers, and their very great influence on the people of the present day, as was evidenced in their songs, sayings, and tales, some of which he (Sir Richard) had had the pleasure of publishing for the author. Dr. Grierson had now provided them with a large new mine of folklore which would be most valuable in the future. He had given in the paper one or two specimens of the folklore, but there were dozens of such tales in the volumes, valuable from almost every point of view for the study of the religions, customs, and cosmogony of the people. He was also glad to find the author praising the liberality of the Government of India, and certainly in his case that Government had had its reward. He supposed Dr. Grierson had found out the art of exciting that liberality; he was sorry to say he (Sir Richard) had never been able to do so, and so far as his personal work had gone, he had been, and still was, a pecuniary loser every year. He supposed there must have been something wrong in his procedure. Hitherto he had thought that the reason of the great difficulty the elders had in procuring recruits in philology and kindred studies had been that it was a study which did not pay, but perhaps he was wrong even there. At any rate, he heartily endorsed Dr. Grierson's appeal to the young men of India to come in as recruits; and, lastly, he desired to express his pleasure in being present at the modest exposition of a very great work, by a man whose name must always be connected with it.

Sir ATHELSTANE BAINES, C.S.I., in adding his tribute to what had been previously said in favour of the wonderful work which Dr. Grierson was bringing to completion, said he only regretted that it was not published twenty years ago, when he first began to flounder, with Sir Charles Elliott, in the field of comparative philology, and they were all met with the difficulties to which the author had referred in the beginning of his paper. He quite appreciated the work that had been done by Dr. Cust, but at the same time he was also cognisant of its shortcomings, and its narrow scope. The results of Dr. Grierson's work would have been extremely useful to all who had to take, what he might call, a photograph of the extent of the prevalence of the different languages and dialects in India at different times, at the census, and this, of course, was a very small part of the field which had to be covered by a philologist. At any rate, it had showed what was a very important part

of the work of a philological inquiry, how the different languages that were prevalent, to a certain extent, at one time had died out of use, and sometimes had disappeared altogether, particularly in the case of tribal languages, even within the life of a single English official generation in India. Every one who had been in India for some time, and took an interest in the subject, would know that there were languages which were rapidly disappearing, either by ceasing to be spoken, or becoming overlaid with the superior classes of language which were gradually invading their strongholds, and confining the other languages to the forests in Central and Eastern India. He had had to grapple with the question that Dr. Grierson had now settled once for all, namely, the differentiation of dialect from language. In India that was a peculiarly difficult work, and before Dr. Grierson's time the efforts that had been made were very largely failures. It was not possible, with the study that an ordinary Indian Administrator was able to give to the language of the country, to grasp the distinctions which Dr. Grierson had shown in his survey between what was really a distinct language and what was a dialect. Very often too great a stress was laid on the differences in vocabularies and similarities in vocabularies. A language was discovered in which the vocabulary was so like that of another language that it was assumed to be the same; but on looking into the construction, it was found entirely different. Such matters had been fully described in Dr. Grierson's work, which was a possession for ages, and which was the foundation, he was sure, of a very large extension of the modern science of philology and research in India, and was already bearing fruit in the conclusions of Dr. Schmidt of Vienna, which were remarkably far-reaching. He desired to ask one or two questions with regard to what Professor Max Müller called the unholy alliance between ethnology and philology, a point on which Sir Richard Temple was very emphatic. When one dealt with large areas of languages, which had been developed by separate nations, generation after generation, no doubt they were led constantly into fallacious conclusions by arguing from language to race or from race to language. He did not know whether the author would agree with him, but, in considering small areas and small populations living practically contiguous to one another, the alliance was not by any means so unholy or so historically defective as one was led to expect. They had been led to blame philologists for extending their family classification to great races, as in what was called the Aryan family; but when one dealt with small tribes like the Kol and the Dravidian tribes of Central India, he thought it could be fairly argued that the connection between philology and ethnology was much closer. He was an unrepentant follower of a school which did connect very largely ethnology with philology, provided there were physical characteristics, or some historical movement —of which there were very good evidences occasionally in India—which had left a tribe, as it were, a derelict behind it, either in its upward course and subsequent retrocession, or a movement in which the whole of the race and the tribe had been swept away. The philological instances which Dr. Grierson had given might be considered to have a high ethnological point of view. Dr. Grierson, however, did not refer to the case of the Brahui people. He had in the last four or five years read some evidence, coming from a totally unsuspected source, which had led people to suppose that the Brahui people were derelict; but he was inclined to think they were the high water of what were called the Dravidian people, who once extended more or less continuously up to the Mekran hills, west of Karachi, up the hills on the borders of Kelat. They were still resident there, and were derelicts of a much larger extension of the dark races. In the same way with regard to the Khâsi, which no doubt was an island rising above a flood which had swept the Mon-Khmer to the east. One of the most interesting points in the paper, to his mind, was the mention of the discovery in the central valleys of a Tibetan tribe speaking a tongue with a Kol-Kherwari basis. It seemed to him that that, with other geographical considerations, was a point, not only of the highest philological but also of the highest ethnological value. The establishment of that relation so far north from the principal habitat was of the greatest importance, and he thought it would turn out very useful as their knowledge grew. There was no doubt a great confusion, as Dr. Grierson had shown, between the Dravidian and what may be called the Kol-Kherwari dark-skinned tribes in Central India, but in spite of all the incursions of the Dravidian races within and beyond the area now occupied by the Mundari tribes, it was seen that, as a general rule, the Mundari tribes had always occupied the northern parts of the hills and the Dravidian tribes had always been in the south. If they were now found on the northern sides that was comparatively a modern invasion, since the Dravidian tribes now inhabiting the central forests came from an origin sometimes Canarese, or Telugu, and there was a gap in which the tribes spoke a language akin to Tamil. That showed that the forest Dravidians were not the derelicts of a wave which formerly went north, but the outposts of an advance into the Mundari country. If that conjecture was correct it seemed that the whole of northern India at the time of the Vedic writers, was peopled by the black-skinned, dark and hairy races, belonging more to what were now called the Kol-Kherwari, which probably extended a good deal further to the east than those writers suspected, and that the Dravidian tribes were not met with until the Aryan went further south across the Vindhya. It seemed to him that those ethnological deductions could fairly be made from Dr. Grierson's philological discoveries.

Mr. J. F. Fleet, C.I.E., said that from what

had been told them that day he thought he might justly claim that the results of the Survey illustrated in a special way the general value of the Indian Civil Service and of the connected service of Military men in Civil employ; not only in the shape of the ultimate results given to us by Dr. Grierson, who had himself been a distinguished member of the Civil Service, but also in the co-operation given by the local officials, themselves members of one or other of the two services, in collecting the materials on which those results had been based. There was no department of work, or of research, in which the members of the Indian Services were not ready to do their utmost, when the demand was made upon them. It was only a matter for regret that, of recent years, the burden of administrative work had become so great that the average Indian official could not find appreciable leisure for scientific work on his own account. He was little prepared for the information that the languages reported from the Survey area were 231 and dialects 774. These figures startled him. And they would have startled still more some of their ancient Hindu friends. The largest number of Indian languages specified by any ancient Indian writer, as far as he could discover, was that given by Nagavarma, a Kanarese writer of about A.D. 1000. In his well-known work on prosody, he had placed the number of languages at 59½. He had mentioned 3½ *bhasha* or parent-tongues; Sanskrit, Prakrit (by which he meant all the various Prakrits classed together), Apabhramsa, and Paisachi; the latter, the language of the supposed half-demon tribes of the extreme north-west corner of India, being, apparently, the tongue which he estimated at only half a language. Beyond that, he held that India was divided into 56 countries, each of which had its own *bhashajati* or vernacular. Thus, even Nagavarma counted only 59½ languages. He would have been greatly startled by the modern total of 1,005 languages and dialects, and Dr. Grierson was to be much congratulated on having reduced that total, for practical purposes, to 147 languages, plus a greatly cut down, though apparently as yet not exactly counted, number of dialects. The programme of the Linguistic Survey had been laid out so as to exclude, so far, the great non-Aryan vernaculars of Southern India, in which he took a special interest because so much of his life was spent, and so much of his work was done, in the Kanarese country. The omission of those languages was a great disappointment to other people, besides himself. And it was a serious loss,—a decided imperfection in the scheme of the Survey, if he might venture to speak so strongly; because, not only were two of those languages historically far older than any of the present vernaculars of Northern India, but also in richness of vocabulary, in mellifluence of sound, and in power of expression, they far surpassed any of the Aryan vernaculars. He ventured to hope that the scheme of the Linguistic Survey might even yet be extended, so as to include the non-Aryan vernaculars of Southern India,—Kanarese, Tamil, Telugu, Malayalam, Tulu, and so on.

Mr. A. Yusuf Ali, LL.M., I.C.S., said he had had the privilege of acting as a private in the vast army of people who assisted in the Survey; and he remembered that in collecting the materials for two of the languages, the work completely took hold of his imagination, in a way in which the larger work had evidently taken hold of Dr. Grierson. He (Mr. Yusuf Ali) thought it might be said, from the result of the Survey, that among the Aryan languages of India there was a certain amount of underlying unity, which also showed an underlying unity in the thoughts and ideas of the people who spoke the different dialects; and it seemed to him that that unity should find a certain amount of expression in the alphabet which was used for the expression of those languages. The alphabet was a great difficulty to people who came to India and had to learn it for the first time at a rather advanced age; and he thought that if in some way the Roman alphabet—the English alphabet, could be introduced in the writing, at any rate of the records and of the business correspondence, they might perhaps be able, at the sacrifice of the picturesqueness which characterized the old alphabets, to advance the practical utility of the languages, and the ease with which they could be learned. The Marathi, Gujarati, Hindi, and Bengali languages were all closely allied to one another, but there were separate alphabets in all of them. These alphabets were derived from a common parent, viz., the Sanskrit alphabet, but the different forms which they had assumed constituted a barrier between the different sections of the Aryan community. If the Bengali and Behari were reduced to a common alphabet a Bengali would understand a Behari with as much ease as a Frenchman can understand an Italian. The question bristled with difficulty, but he thought it was arguable that if in the official records and in the business records a single alphabet was used it would emphasise the ultimate basic unity of the different languages, and besides helping the work of administration and of commerce and saving expense, would also, he thought, enable the different people of the different parts of India to understand each other better, and to approach each other nearer. He was quite aware that when that question had been mooted a number of objections had been raised, which he did not desire to minimise, but at the same time he brought the point forward as a suggestion, which possibly Dr. Grierson might have some opportunity of considering and giving his opinion upon.

Dr. John Pollen, C.I.E., after expressing his personal appreciation of the admirable paper of his old friend and schoolfellow, said that Ireland was proud of Dr. Grierson, and that Great Britain had every reason to be very grateful to him. He (Dr. Pollen) could not help feeling that they must all have

experienced a feeling of despair when they heard of the innumerable languages spoken throughout the length and breadth of India. Probably they thought that there was no hope for the foreigner, because it was perfectly impossible to acquire knowledge of all the various languages, or of the beautiful folklore which had been translated into English. English people, of course, would benefit by that translation, but there were hundreds of thousands on the Continent who would never hear of the author's translations. But he was an apostle of the Gospel of Hope, and he assured those present that the riddle would be solved by the translation of all languages into Esperanto — the simplest and best international language.

Sir GEORGE BIRDWOOD, K.C.I.E., said no one more cordially shared than himself the high esteem in which the learned Dr. Pollen was held not only as a distinguished Indian administrator but as a scholarly Orientalist, but when he deliberately intervened in the discussion as the solemnly announced President of the "Language of Hope," and talked of the conversion to Esperanto of the many languaged people of India, with the consequent obliteration of the glorious diversity of their vernacular literatures, he (the speaker) could not but say that the introduction on the present occasion, and in that room, of such a prosthesis, was as the abomination of desolation standing in the holy places of Israel. Esperanto was not only useless as another "code," but in its very conception as a "perfected language" was mere silliness and stupidity, impossible, and unthinkable. They had sat with little profit at the feet of Dr. Grierson that evening, and had spent their lives with little profit in India, one of the great foci, and a veritable seething cauldron, of the natural evolution of languages, if they had not learned that they grow up of themselves, and in absolute spontaneity, and cannot be artificially manufactured. As for any one with a spark of human fire in him wishing to reduce all languages to one, and all literatures to a universal uniform expression, it was the wickedness of sheer thoughtlessness to dream of such an absurdity. Would any sane man desire to quench the light of all the rich and rare gems of the sea to one monotonous, achromatic ray? Or to subdue all the free flowering flowers of earth to one pattern and colour? Words are flowers of the human soul, the expression of its feelings, desires, thoughts, experience, fears, and hopes; and through the centuries, blossom on blossom, they reach their maturity n naturally organised languages. In a literature these come to their spring, reach their summer, decline into their autumn, and in their winter die. It was impossible for a people whose native country was, say, Poland, to form a language for a people living, say, in France; and you could not by violence supersede the indigenous languages and literatures of India by the language and literature of England without dislocating the continuity of the moral evolution, and destroying the historical personality, of the people of India,—the meanest crime one nation could commit against the internal consciousness, and intellectual integrity, of another nation. Even the same race, if a great race, with a great and deeply-moving past, cannot to-day use with sincerity and efficiency the same language it used 2,000 years ago. Within 500 years, see how our common English speech has changed from Chaucer and John Gower to Spenser and Shakespeare, and from Milton and Marvell to Wordsworth and Swinburne. He had no manner of authority to stand up as a critic of Dr. Grierson's most informing, brilliant, and inspiring paper. He had listened to it with undivided pleasure, not only for its intrinsic merits and the credit it did Dr. Grierson, but for the honour it reflected on the great Indian Civil Service, and the Government of India. The folk-lore tales had particularly delighted him, and he hoped that some of the young ladies, who did that sort of work so admirably, would be tempted to collect into one or two volumes for general readers the best of these stories, the authenticity of which was beyond all cavil, from the rich stores to be found in the reports of the Linguistic Survey of India already prepared by Dr. Grierson. He would also like to make a similar sub-editorial suggestion for the addition to Dr. Grierson's introductory list of the names of those, the heroes before Agamemnon, especially from the Bombay Presidency, who had worthily contributed to the augmentation of our knowledge of the languages of India. Sir Erskine Perry, son of the founder of the old *Morning Chronicle*, wrote a most suggestive paper for the Bombay Branch of the Royal Asiatic Society on "The Aboriginal Tongues of India" and his "Birds'-eye View of India," was an excellent popular review of the races and languages of India. The names of Molesworth and of Candy, the authors of the first Mahratti and English Dictionary should hold a conspicuous place in the list, as also the name of Taylor, the author of the first Canarese Dictionary. Then there was Raverty of the 3rd Bombay Native Infantry, the author of the first Pushto Dictionary, and of a most useful List of Hindustani Technical Terms. He was one of the many brilliant Irishmen who have so ably contributed to build up, and, by their sympathetic qualities, to strengthen the fabric of the British raj in India. He would further cite the names of the three brothers Schlagintweit, Adolphe, Herman, and Robert. It is true they were Germans, but all good Englishmen are Germans, and Adolphe sacrificed his young life in our service. Then there was Leitner, the latter Mezzofanti of the nineteenth century, whose writings on Dardistan and Hunza were surely notable samples of pioneer work in the linguistic survey of India. Finally, and only so because the hour was so late, he would mention Childers — Robert Cæsar Childers— cut off in the early summer of his life, but not before he had gained his imperishable place in the records of Oriental research by his identification of the Aryan

character of the Sinhalese language, and by the publication of the first Dictionary of the Pali language, the most fascinating of all the great works on India he (Sir George Birdwood) had in now long past years the honour to review for *The Times*.

Dr. GRIERSON, in reply, thanked the speakers very heartily for the kind way in which they had spoken of the Survey and the part he had taken in it. It was very cheering to him to find that people in general took such an interest in the work. With regard to Sir George Birdwood's remarks on the subject of the names mentioned in the introduction of the paper, he did not pretend for a moment to offer a complete list of all the names, but had only mentioned one or two as a guide; and if Sir George would, in his contribution to the discussion, add the names, it would be a most valuable contribution to the bibliography. He was afraid that the subject of writing the alphabets in Roman characters, mentioned by Mr. Yusuf Ali, was too thorny a subject to enter into that afternoon. He could only say in that connection that, having had to deal with nearly every Indian alphabet, he had found it a subject which was almost maddening in its complexity. With regard to the subject of ethnology and philology, he agreed with Sir Athelstane Baines that though, as a general rule, a language could not be taken as deciding the race of the people who spoke it, he was glad to be able to agree with so distinguished an ethnologist as Mr. Risley, in considering that it could be done in some cases, *i.e.*, when there was a language which was dying out, or a small tribe losing its language and gradually becoming Aryanised, they were generally safe in assuming that its original language indicated the authentic relation of the people. Tones undoubtedly did represent inflections which had been worn away and had left hardly any other trace. This was proved by Conrady in his well-known work on the subject. He would like to add that he was at one with Sir Richard Temple in doubting if the Mon-Khmers were the aborigines of the Indo-Chinese country.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Dr. Grierson for his interesting and valuable paper.

Mr. J. D. ANDERSON, who was prevented from taking part in the discussion, writes:—As a very humble contributor to one of Dr. Grierson's volumes, I should have liked to bear testimony to his extraordinary kindness and indulgence to his amateur assistants, most of them men without any pretensions to scholarship, — mere practical linguists, whose empirical acquirements were welded by Dr. Grierson's skill in organising his great work into the result which has won even wider admiration and appreciation in France and Germany than here. Mr. Anderson adds:—In my own case, I was astonished to find how instantaneously and completely Dr. Grierson assimilated the linguistic information I was able to give him, and how unerringly and swiftly he co-ordinated it with the materials already at his disposal. Until he undertook the Survey, Dr. Grierson was known to the world as a student of the Indo-European languages of India. To me it was surprising and delightful to see with what practised ease he acquired the linguistic peculiarities of groups of languages that have little in common with European speech. To most people, an "agglutinative" language presents the most depressing difficulties at first sight. To Dr. Grierson such difficulties were obviously a stimulus and, I had almost said, an amusement, so easily did he grasp the mentality which underlies the syntactical methods of savage speech. Those who know one or two Indian languages can best understand the extraordinary intellectual feat involved in giving a reasoned and comparative account of *all* the languages of India. Nor must it be supposed that the accounts of the different languages of India, though necessarily brief, are superficial. In the case of those with which I am acquainted, there has been the most masterly selection of the essential matters, the salient points of linguistic difference which mark off the different families of Indian speech. To any one interested in linguistics, Dr. Grierson's big volumes afford the most suggestive and delightful reading. He has achieved what Brian Hodgson could only, with the materials then available, attempt. No doubt, as Continental linguists are beginning to find out, much remains to be done in matters of detail. But nothing can supersede the outline map, as it were, of Indian linguistics which Dr. Grierson has been the first to draw. Those who work at details must use and follow his broad indications, and these will make linguistic work in India easier, because more scientific and intelligent, for all his successors.

Mr. T. C. HODSON writes:—I am glad of an opportunity of adding my humble tribute of admiration for the great enterprise which Dr. Grierson has so successfully carried out. As a student of Tibeto-Burman dialects, I can speak of the help which the report has given me, and I can speak with sincere gratitude of Dr. Grierson's unwearying courtesy in answering all sorts of inquiries. The variety of the Tibeto-Burman dialects is well shown in Manipur, where we have representatives of the Naga as well as of the Kuki languages, where in the Meithei, the language of the dominant people, we have a stately language possessing no mean literature, and where the variety of dialects is aptly paralleled by the variety of ethnical development which is superimposed on a fundamental unity of social structure. Just as there are tribes which link up the Kukis with the permanently settled Nagas, so there are dialects which partake of the characteristics of both groups. Dr. Grierson has drawn attention to the effect on the vocabulary of these tribes of what, for want of a better description, I have elsewhere called the habit of parti-

cularism. This habit of insisting on the differentia of phenomena to the neglect of their essential unities is corollary to the industrial plane of the people. Where everything is made by hand, there is no type, no mould, no pattern. There can, therefore, be no mental presentation or idea of a "type." This was first brought home to me by noticing how, of all the impedimenta with which I loaded myself, shaving mirrors, repeating rifles, tabloid medicines, nothing excited the wonder and admiration of the hill people so much as the uniformity of coined money. We are familiar with the monotony of machine-made things but to them it was magical. Is not this habit of particularism which, as Dr. Grierson has shown, is realised linguistically, the essence of the religious plane which we call "Animism?" One word more. I can speak with knowledge of the difficulties, political, politico-religious and sentimental which beset the path of the reformers of the characters of the Indian vernaculars. In Manipur the old Meithei character is ousted by the crabbed, tortuous Bengali character, so that the course of what is called progress there, will end, I fear, in the loss of the distinctiveness of Manipuri literature, for the literature of Bengal will come with the character and, though the hills will long escape the deadly influence, the people of the broad land of the Meithei will lose all knowledge of their own literature. There the mischief is done. But I hope that never again will the mistake be made of using the Bengali character in transliterating a hill language. It was used in transliterating the Garo language, while the Roman character was employed in transliterating the Khasi language. I do not doubt that there is an intimate relation between the excellence of education in the Khasi hills and the adoption of the simple Roman character. For myself, in the grammar of the Thado dialect which I have prepared, I have followed the very careful scheme of transliteration which Sir Charles Lyall drew up years ago when he was, I think, a member of the Assam Commission. I hope that, in the near future, men will arise who will learn the hill dialects, and will use them as well as did McCabe whose name is still loved and remembered by the Angamis. Dr. Grierson's labours have cleared the way for new work, and though the workers are but few, the harvest is already rich.

ARTS AND CRAFTS.

Jewellery.—Until towards the end of the nineteenth century jewellery, from the point of view of art, seemed to be of very little account in this country. It had come to be taken for granted that English jewellery was very good and very solid. It was all that, but it was also very dull and monotonous. If people wanted novelty, lightness, fancy, elegance, or any other quality which savoured of something not to be successfully measured by £ s. d. they might go to Paris or elsewhere to look for it if they liked but they must not expect to find it at home. The last ten years has changed all that. It is now to jewellery that we turn to see the most up-to-date developments of the newest art. The Victorian style is here quite a thing of the past, and most happily so. There are, however, facts connected with this development which are interesting in themselves and also throw a good deal of light on the forms of modern English jewellery. Of course it is not only in England that there have been marked advances in the art of the gold and silversmith. So long ago as the Brussels Exhibition of 1897 M. Lalique was showing masterly and most remarkable work, and since then we have seen a great deal of wonderful work by the same master, by M. Gaillard and others, characterised by consummate technical skill and an intense, if somewhat weird, imagination. Our English movement has been singularly unlike the French one and carried on in a typically and peculiarly British temper. The pioneers of artistic jewellery on the other side of the Channel were evidently, as their work shows, masters of their trade, trained and skilled gold and silver smiths who had been through a severe course of workshop training in technique, and whose art was, in a measure at least, the outcome of their practical knowledge, the result of that perfect command of their medium which made them desire to do in it what had never been done before. In this country, on the contrary, the origin of the movement was an artistic rebellion against the banalities of the trade. Our new artist-jewellers were first of all artists and only in the second place jewellers. They started with the conviction that modern English goldsmith's work was all wrong, and with a fervent and laudable desire to put it right, but they were not most of them jewellers to begin with. By training they were artists, and by profession sculptors, metalworkers, modellers, and the like, not gold and silver smiths; they had to learn their trade more or less as they went along, and for a while, until they had learnt it, their work suffered from their lack of experience. Who does not remember some of the trials of that early "arty crafty" work; the massive rather sculptural brooch that compelled attention and that, as its wearer pathetically owned, was a severe strain upon the collar it was supposed to fasten; the chains, designed, may be, by a quondam worker in iron, irresistibly suggestive of fetters; and the more delicate little collar, which ought to have lain flat but which would persistently go wrong at the joints so that here and there a portion stood up edgewise or turned over on its face. Such little deficiencies may not be entirely things of the past, but they are by no means so frequent as they were, and the movement is bearing fruit, as may be seen at art exhibitions and in shop windows, in two ways. First, a class of artist craftsmen has arisen, consisting of men and women who have learnt their trade and who have sufficient artistic training to enable them to produce work which is both pleasing and interesting. Then, a marked change has come over the character of trade jewellery. It still, of course, leaves a good deal to be desired. Some of it is up-to-date in a rather ridiculous way;

but still the trade shows signs of life. If we walk down Bond-street, or Regent-street, or even Cheapside, we do not see what we should have seen ten years ago. The artistic influence has touched the trade—only indirectly it may be, by creating a demand which the manufacturer had to supply—but it has touched it, and having done that much, there is every hope for further developments.

It is rather curious to note in connection with the design of this work, how inevitably, in the course of evolution, the swirls of the would-be modern work resolve themselves into the well-known forms of rococo ornament. As a matter of fact, at the present time the greater part of the hand-made jewellery which is not filagree pure and simple, is quite pronouncedly rococo in feeling, not presumably because its makers set out to copy work of that period, but because the carrying further of the modern swirl seems to lead naturally and inevitably in that direction.

Enamel.—A branch almost of jewellery and goldsmith's work is enamel, or, to be more strictly accurate, the art of *cloisonné* enamelling, for *champlevé* enamel is more nearly allied to the smith. There was a time in the days of the Celts and the Anglo-Saxons, when Britain was apparently a centre for the production of *champlevé* enamel, but in *cloisonné* work she never seems to have excelled, and there is no English work to compare with the translucent enamels of Limoges and the more modest *finift* of Russia and *drahtemail* of Hungary. However, in the last few years the art has not only taken root in this country but it has become the prevailing fashion, everything is liable to be enamelled nowadays — from our watches to our coal scuttles. It has often been used simply to get bright effects of colour in jewellery without employing precious stones, and in this way its effects have been most happy. Many a piece of modern goldsmith's work is immensely helped by the points of bright transparent enamel on it. The material is not expensive in itself and it is generally too far away from the colour of precious stones to enter into competition with them; and thus it gives a brilliant effect, about which there is no suspicion of sham, at a much lower cost than would be possible if the stones themselves were used. But the efforts of the twentieth century English enamellers have not stopped short at the production of this modern form of goldsmith's *cloisonné*. A good deal of very ambitious work has been done in the way of enamelling pictures after the manner of Limoges—"after," it must be owned, in more senses than one. It is easy, working in a medium like translucent enamel, to get beautiful, if somewhat uncertain, colours with a very little knowledge of technique, and delight in what has been so quickly achieved keeps the worker back instead of urging him to improve his technical and scientific knowledge of his material. Again, it is more difficult for the enameller than for almost anyone else not to be led away by the praises of the technically inexpert who can see the beauty of colour but are not competent to judge of workmanship. Still the technique of these enamel pictures has been and is steadily improving, which speaks well for the determination of their makers. Opaque *champlevé* enamel has not by any means kept pace with the lighter, and in some respects more taking, transparent and *cloisonné* work, but it is satisfactory to note that something is being done in this direction also. There were several fairly important specimens of this type of enamel at the Arts and Crafts Exhibition which point, it may be confidently hoped, to the further development of this other side of the enameller's art.

Design.—There has been a decided falling off in the matter of design within the last few years. Some time back everything was patterned and nearly all patterns were of the all-over kind, to-day people are inclined to paper their walls with a plain-coloured paper or with perhaps a stripe, leaving what ornament they have to find its place in the frieze. The same tendency runs through printed and woven fabrics, carpets and linoleum. This may be the natural reaction from the squirming and swirling of *l'art nouveau*. People who have been living for a year or two with the most pronouncedly and eccentrically up-to-date hangings, carpets and papers, may well long to rest their eyes, but there is another reason which suggests itself. The outcry against academic training in art which has had so much effect upon the schools all over the country, has made the student see the value and the necessity of designing with a definite purpose, of making his drawings really working drawings fit to be carried out in some particular material or by some special process. It has moreover encouraged him to make designs mainly for things which he can execute himself—with the result that the clever young designer of the rising generation has turned his attention to stencilling, jewellery, embroidery, or some other craft in which he could, more or less, execute his own designs. Manufacture proper he is inclined to leave rather severely alone. He prefers to work independently and to be bound by conditions less rigid than those imposed by the machine. Considering how large a proportion of our products are and must be made by machine under strictly commercial conditions, it seems sometimes almost a pity that so much more energy, comparatively speaking, is spent by artists on designing for hand-made things. Meanwhile, whatever the cause may be, we have only to look at the new things being shown by our large firms to be made aware of the fact that design for manufacture somehow lags behind. The spots and dots and sprig patterns, which were so universal last year, seem, it is true, to have retired to casement curtains and carpets, but their place has been taken by mere stripes of a singularly dull description, whilst the would-be French designs which had so great a vogue a short time ago have given way to heavy rather naturalistic work of the early Victorian type. It is really lamentable that, with so many facilities of art education, the standard of design for manufacture should be so low.

that we have to go back to what is admittedly one of the darkest periods of art for the patterns with which to deck our homes. It is easy to say that that is what is wanted; but who wants it? and is the ordinary person so incapable of knowing his own mind as to really prefer *l'art nouveau* one year, Louis XV. the next, and early Victorian the year after? If that be so, it should surely be an easy matter to induce him to prefer something good.

CORRESPONDENCE.

MOND GAS AND POWER TRANSMISSION.

A copy of Mr. Martin's paper was received by us only a few hours before the paper was to be read, and we much regret that, as owners of the Mond gas patents, Mr. Martin did not ask us for information as to the cost of manufacture of Mond gas, as we should have been only too glad to give him information on this subject and also on the question of the transmission of gas, in which we have had considerable experience. We were able to place in the hands of Mr. Martin statements of the cost of producing Mond gas, which have now been published for some years. Under favourable circumstances, even better results have been obtained in practice. These statements are shown in Table attached.

From the Table it will be seen that, taking coal at the price mentioned in Mr. Martin's paper, namely, 6s. per ton, the cost of manufacturing Mond gas would have been about one-third of that stated by him. There is no doubt that at the pit's mouth bituminous slack, suitable for use in Mond producers, can be obtained at 3s. 6d. per ton; and if an allowance for this is made in the Tables, and at the same time the sulphate of ammonia is taken at the present market price of £12 10s. per ton, instead of £10 per ton, it will be observed that the by-products more than pay for the actual cost of the gas, and leave a considerable sum over towards the cost of compression and transmission. The diagram (Fig. 5) would then need to be altered to such an extent that Mond gas would then prove to be much cheaper to manufacture, compress, and transmit than either coal-gas or water-gas, and this without making any changes in the cost of compression and transmission from the figures assumed by the author, which would carry us too far afield to discuss it at the present time.

Under the heading of "Our National Food Supply," the author draws attention to the necessity of providing chemical fertilizers for the growth of our future wheat crops, in order to keep pace with the demands for wheat of a growing population. In this connection it should be noted that by the Mond process four times as much sulphate of ammonia is obtained per ton of coal as can be obtained by the process of converting coal into ordinary illuminating gas.

We fully agree with the author of the paper that the supply of a cheap gaseous fuel, which while entirely overcoming the smoke nuisance, would lead to enormous economies in the use of coal, is one of national importance, and that the subject will continue to force itself upon the attention of local authorities, especially those who have charge of public matters in large cities where smoke and fog are so troublesome, until schemes, perhaps more modest than that proposed by the author, but still somewhat on the same lines, become accomplished facts.

EMILE S. MOND.
Managing Director.
The Power-Gas Corporation, Ltd.,
April 9th, 1906.

Statement of Annual Working Cost of 20,000 *horse-power Plant with Ammonia Recovery, working continuously at full load, for* 365 *days of* 24 *hours.*

	£	s.	d.
Total fuel (91,250 tons) including that required to raise all necessary Steam at 6s. per ton	27,375	0	0
Wages at producers, boilers, sulphate recovery and evaporating plants, including handling of coal and ashes, also shipping of sulphate ..	4,859	0	0
Sulphuric acid (at 30s. per ton), also lubricants, lighting, stores, repairs (including wages and materials for same)	6,456	0	0
	£38,690	0	0
Less 2,920 tons sulphate at £10 per ton	29,200	0	0
Net cost per annum	£9,490	0	0
Cost of available gas per 1,000 cubic feet	d. 0·2213		

Statement of Annual Working Cost of a 20,000 *horse-power Plant with Ammonia Recovery, working under a variable load which is equal to half load throughout.*

	£	s.	d.
Total fuel (46,125 tons), including that required to raise all necessary steam (and also standby losses of half plant when standing for 12 hours every day), at 6s. per ton	13,837	10	0
Wages at producers, boilers, sulphate recovery and evaporation plant, including handling of coals and ashes, also shipping of sulphate	4,133	15	0
Sulphuric acid (at 30s. per ton), also lubricants, lighting, stores, repairs (including wages and materials for same)	4,010	10	0
	£21,981	15	0
Less 1,460 tons sulphate at £10 per ton	14,600	0	0
Net cost per annum	£7,381	15	0
Cost of available gas per 1,000 cubic feet	d. 0·3467		

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FRIDAY, APRIL 20, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, APRIL 23, 8 p.m. (Cantor Lecture.) ALFRED MASKELL, F.S.A., "Ivory in Commerce and in the Arts." (Lecture I.)

WEDNESDAY, APRIL 25, 8 p.m. (Ordinary Meeting.) FREDERIC T. CORKETT, "The Production and Collection of the Picture Post-card."

THURSDAY, APRIL 26, 4.30 p.m. COLONEL SIR HENRY McMAHON, K.C.I.E., C.S.I., "Seistan: Past and Present."

Further details of the Society's meetings will be found at the end of this number.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday, March 20, 1906; WILLIAM A. LINDSAY, K.C., F.S.A., Windsor Herald, in the chair.

The CHAIRMAN, in introducing Mr. Davenport, said that the audience were doubtless aware that one of the most beautiful books which had been published within the last ten or fifteen years was his work, namely, a finely illustrated book on the Coronation Regalia; and he (the Chairman) had no doubt that Mr. Davenport would give them as interesting information about regal heraldry as about coronation regalia.

The paper read was—

ENGLISH ROYAL HERALDRY.

By CYRIL DAVENPORT, F.S.A.

Heraldry is largely the outcome of the almost universal symbolism which is found among the remaining traces of primitive peoples. Signs like the swastika and triskele, which were in all likelihood astronomical, represent a large group of these marks, and another large group can be found which owe their origin to natural forms, as, for instance, the Egyptian "Ouza," or sacred eye.

These signs were worn as personal ornaments as well as doing duty on rocks, buildings, and works of art. But at a period when savage men gathered themselves together into families or tribes, we find tribal marks or Totems, and these I imagine are the prototypes of our modern heraldry where all members of the same armigerous family use the same coat-of-arms, supporters, crest, and motto.

Heraldry, as we know it, is a mediæval art, fostered particularly during the Crusades, when armour reached a state of development in which it entirely covered up the wearer. It was obviously necessary to have some outward and visible sign of the identity of such a warrior, and an easy way to obtain this was the addition of some personal badge on the top of his helmet, hence the crest, which is a personal mark, and should never be worn except by the person entitled to use it. A crest on a livery button is wrong; the proper mark on a serving-man's dress is a badge.

Besides the crest, the shield offered an obvious field for distinctive marks, but it had the disadvantage of being easily lost, so the crest on the helmet was originally the more important. Kings wore circlets of gold over their helmets, and many interesting adventures resulted.

At tournaments and on State occasions knights had the caparisons of their horses emblazoned with their arms, and also their own surcoats. At tournaments, knights not

actually fighting had their shields carried by pages, who were often dressed in fancy costumes, often in the form of animals, hence the heraldic supporters.

The traditional coat-of-arms of Normandy is "Gules, two lions guardant or," and it is supposed that this coat was used by our Norman kings with the exception of Stephen —who is credited with three centaurs with bows and arrows—Sagittaries. At the same time it must be said that there is no official authority for the existence of the two lions until about 1180, when they show on the seal of Prince John, Lord of Ireland (Fig. 1), in which case the Prince, on horseback and in armour, carries a shield on which are two lions passant guardant.

FIG. 1.

SEAL OF PRINCE JOHN, about 1180, showing the Two Lions of Normandy.

Henry II. married Eleanor of Aiquitane, and the traditional coat-of-arms of that country was "Gules, a lion guardant." St. George was, moreover, the Patron Saint of Aquitaine. On the second great seal of Richard I., the shield carried by the King shows three lions, and this coat has remained the coat-of-arms of England until the present day, that is to say for a longer period than the royal coat-of-arms of any other nation. The only interregnum was during the Commonwealth. We have seen that Normandy was credited with two golden lions on a red ground, and that Aquitaine was credited with one golden lion on a red ground, and so we may presume that Richard combined the coats of his father and his mother, and so arrived at his three golden lions on a red ground, the oldest royal coat in Europe.

This same coat was used by Richard's successors until the time of Edward III., but on his third Great Seal, made in 1340, he uses the coat-of-arms of France, "azure semée de Fleurs-de-lys or," (Fig. 2), quartered with England. His reason for doing this, as well as for his assumption of the title "Rex Franciæ," was that he claimed the throne of France by right of his mother Isabella, daughter of Philippe IV., as her three brothers (Louis X., Philip V., and Charles IV.) died without any heirs. The French coat as well as the title was retained by our English sovereigns until the Legislative Union of Great Britain and Ireland in 1801. The crest of a lion statant shows clearly on the great seals of Edward III., on a cap of maintenance, but afterwards it is shown on a royal crown.

FIG. 2.

ARMS OF EDWARD III., from the Black Prince's Tomb at Canterbury, showing the use of the French Coat Semée with Fleurs-de-lys.

In early descriptions of coats-of-arms the animals shown on the English coat are described as leopards. The reason for this is that heraldically a lion is a rampant beast, showing only one eye, one ear, and standing upon one foot. In any other position he was described as a leopard and considered to be acting the part of one. In such cases, however, the animal only bears that name as an heraldic title. A true heraldic leopard has spots, no mane, and an untufted tail. Our English lions have manes, no spots, and tufts at the end of their tails. Any lion not rampant may heraldically be called a "lion-leopardé." Golden lions on a red ground are "langued and armed azure," that is to say, they have blue tongues and blue claws.

Edward seems at first to have used the English coat before that of France, as Howes in his "Chronicle" says that "Touching the title and armes aforesaid the French king (Philip

VI.) said to certain English men sent to him "our cousin" quoth he "doth wrongfully beare quartered the armes of England and France, which matter notwithstanding doth not much displease us, for that he is descended from the weaker side of our kin, and therefore as being a bachelour, we would be content to grant him licence to bear part of our armes of France. But whereas in his Seals and Letters Patents, he nameth himself as well King of England as of France and doth set the first quarter of his arms with Leopards, before the quarter of Lilies, it doth grieve us very much, making apparent to the beholder that the little island of England is to be preferred before the great kingdom of France." To whom Sir John Shoreditch, Kt., made answer "That it was the custom of men in those days to set the title and arms of their progenitors before the arms and title of the right descending of their mother; and thus of dutie and reason doth my Lord the King prefer his arms."

Nevertheless the protest of the King of France found favour in Edward's eyes, and he and his successors, until the time of William III., allowed the arms of France to remain in the first quarter.

We are told in manuscripts* that Edward III. used as supporters a crowned lion guardant, or, and a falcon, or, but I expect these were only badges. Badges did, however, in many instances suggest supporters.

Richard II. used the same coat, and there is a sculptured coat-of-arms of his at Westminster-hall, beneath which is the badge of a white hart, the cognisance of his mother, Joanna of Kent. Richard married Isabella of France, whose father, Charles VI., reduced the lilies semées of France to three only. Henry IV. at first used the lilies semées, but in 1408, in his Great Seal, he reduced them to three (the lilies semées are known as "France ancient," and, when there are only three, as "France modern"), and this coat—"quarterly 1st and 4th, France modern, 2nd and 3rd, England" remained unchanged until the time of James I.

Henry V. is credited with having a lion and an antelope as supporters, but over his tomb at Westminster he has an antelope and a swan. But still I think these are only badges.

Henry VI. shews the coat upheld, in a coloured-glass window at Ockwell's House, Maidenhead (the exact date of which I do not know), by two white harts, derived no doubt from the badge of Richard II.

Now I find a new authority for Royal coats-of-arms. Hitherto I have derived them chiefly from Seals, but from Edward IV. until Victoria (with the exception of Edward V.), there is a splendid series of Royal coats-of-arms on, or in, books which belonged to the sovereigns themselves.

At Westminster there is a loose cover of a book which bears the impression of a panel stamp showing the arms of Edward IV., supported by two lions, ensigned with a crown held up by two angels. Also in a manuscript* which belonged to the king is the same coat and the same supporters. The white lions are doubtless derived from the white lion badge of the Mortimers, Earls of March, ancestors of the King, Willement says Edward V. had a lion and an antelope as supporters, but I cannot find any authority for this; he had no Great Seal.

The Yorkist badge of a silver boar is carved on the steeple of the church at Wolverhampton, and silver boars, armed or, were undoubtedly used for supporters by Richard III., and are shown in a manuscript which belonged to him. (Bib. Reg., 18, A. 12.)

On another manuscript (Bib. Reg., 16, F. 2), formerly the property of Henry VII., is his coat-of-arms with the same two white lions as supporters, but a little later he changed them and adopted a red dragon, supposed to have been the badge of his ancestor, the Welsh prince Cadwallader, as his dexter supporter, and a white greyhound as the sinister supporter. The white greyhound was a badge both of Henry's ancestors the De Beauforts, and of his wife's ancestors the Nevills. Henry VIII. used the same supporters until about 1528, when he gave up the greyhound and moved the dragon to the sinister side, adopting a lion as his dexter supporter.

Edward VI., Mary, and Elizabeth (Fig. 3), all used the same coat and the same supporters, but Elizabeth on one of her Great Seals used for the first time the Harp of Ireland. It also shows in a painting of her coat-of-arms (Harl. 6096), as does also the coat-of-arms of Wales.

Ireland has at various times enjoyed a separate coinage from that of England, and an issue of silver groats of Henry VI. have on the obverse a single crown, no doubt intended for a badge or possibly coat-of-arms. A little later in the reign of the same king appear,

* Harl 1073 and Harl 304.

* Bib. Reg. 15. E. 4.

also on a silver groat, "three crowns in pale," this time no doubt used as a heraldic bearing. This coat was afterwards declared to be the coat-of-arms of Ireland on the authority of a commission appointed by Edward IV.

FIG. 3.

ARMS OF QUEEN ELIZABETH from her Bible, showing the use of the French Coat with Three Fleurs-de-lys, and the Lion and Dragon Supporters.

Henry VIII., however, seems not to have approved of the three crowns in pale, and on an Irish sixpenny piece of 1530 shows a single crowned harp as well as the title "Hibernie Rex." Walker in his "History of Irish Bards," says that Henry bestowed the harp upon Ireland as a coat-of-arms in token of his appreciation of her feats in music. From this time the single harp shows constantly, but on a shilling of Elizabeth, dated 1560, there are three harps, two and one. Vallency says that the Irish harp was sacred to Apollo Grian or Beal, and in the MS. Harl 304, we are told that "the armes of Yrland is Gules III old harpes or, stringed argent." The shield of Ireland is, however, now shewn azure—as it is in Harl 6096, mentioned above. The coat-of-arms of Dublin is three castles, and the triple arrangement here, as well as in the case of the crowns and the harps may have some connection with the ancient triskele, found in perfection in the shamrock, and like the four-armed swastika, one of the most widely spread of early decorated designs.

The coat-of-arms of Wales "quarterly, or, a lion statant gules counterchanged," which shows also in the same MS. Harl. 6096, is really that of South Wales, the coat of North Wales, which shows on the hilt of the State sword of Prince Edward, afterwards Edward V., is "ar, three lions passant reguardant in pale, gules, their tails passing between their legs and reflected over their backs." But the coat of South Wales is generally considered to represent the whole country.

The coat-of-arms of Scotland appears first in the seal of Alexander II., in 1235. It shows continually on coins, and the lion, now truly rampant, is said to have been derived from the arms of the Earls of Northumberland and Huntingdon, ancestors of Scottish kings. The tressure with the fleurs-de-lys is said to have been adopted in compliment to Charlemagne, between whom and King Achains of Scotland, there was a treaty—and a later treaty added the second tressure, but this is all conjectural.

The Scottish supporter as used by James I., in 1429, were two lions rampant guardant, but James IV. is said to have adopted two silver unicorns, royally gorged and chained, or. One of the Scottish kings, as Prince, had some hand in the death of his father, and he wore the chains which are immortalised on the unicorn of Scotland, ever afterwards.

FIG. 4.

ARMS OF JAMES I. from a Binding, showing the, Coats of England, Scotland, and Ireland, and the Lion and Unicorn Supporters.

When James VI. of Scotland inherited the kingdom of England, and came here as our James I., he made an important change in the Royal coat-of-arms. In the first place he used the coat of "France and England quarterly," which had been used by his predecessor, repeated in his first and fourth quarters, then in the second quarter he put his own ancient Scottish coat, and in the third

quarter the harp of Ireland. Not only this, but James abolished the red dragon of Wales, used as a sinister supporter by the later Tudors, and substituted for it one of the Scottish unicorns. (Fig. 4). This same coat and supporters was used by Charles I., Charles II., and James II., and the supporters have remained the same until the present day.

Cromwell used the cross of St. George in his first and fourth quarters, the cross of St. Andrew in the second quarter, and the harp of Ireland in the third quarter, and over all in an inescutcheon the lion rampant of the family of Cromwell, and the later Tudor supporters, lion and dragon.

Fig. 5.

Arms of Queen Anne, showing the Coats of England and Scotland impaled in the first and fourth quarters.

William III. was born Prince of Orange, and had for his coat-of-arms quarterly, Nassau, Dietz, Vianden, and Catsenelboge, over all Chalon, Orange, Geneva, and Buren. When he came to England he used the same coat as James II., but with the arms of Nassau, his original first quarter, "az., semée of billets, a lion rampant, or," in an inescutcheon. William also in many instances altered the order of the various quarterings of the Royal coat-of-arms.

Queen Anne in the early part of her reign used the same coat as her father, but on the Legislative Union of England and Scotland in 1706 (6th March) she made an important change. The coats of England and Scotland are now impaled and used on the first and fourth quarters, France is relegated to the second quarter, and Ireland remains in the third quarter. (Fig. 5). This coat remained in force until the accession of George I.

Before George I. came here he was Duke of Brunswick and Elector of Hanover, and had an elaborate coat-of-arms, ensigned with the electoral bonnet. This coat contained the arms of Brunswick, Saxony, Luneburg, Eberstein, Osnaburg, Homburg and several others, with the crown of Charlemagne on an inescutcheon. When he came to England he omitted the existing fourth quarter of the English coat-of-arms, and substituted for it a representative coat for his dominions in Germany, namely, "Brunswick impaling Luneburg, Saxony in the base point, and the Crown of Charlemagne, in an inescutcheon of pretence, as a badge of the office of

Fig. 6.

Arms of George I., showing the Arms of the German Dominions of the King in the fourth quarter.

Arch-Treasurer of the Holy Roman Empire. (Fig. 6). This actual crown is now kept in the royal treasury at Vienna. It is the finest Byzantine crown in the world. This coat-of-arms was used by George II., and by George III. until 1801, when, on the legislative union of Great Britain and Ireland, the lilies of France and the title "Rex Franciæ" were discontinued, and the Hanoverian coat was put in the centre of the coat of-arms on an escutcheon of pretence, ensigned with an electoral cap, the coat of England being alone in the first and fourth quarters, Scotland in the second, and Ireland in the third.

On the elevation of Hanover to the dignity of a kingdom in 1814, a new Seal was designed, and on the fifth Great Seal of George III., issued on the 1st August, 1815, the electoral cap above the scutcheon of Hanover was changed into a royal crown.

George IV. and William IV. both used the same coat-of-arms, but on the accession of Queen Victoria the scutcheon of Hanover was discontinued, that kingdom, by virtue of the operation of the Salic Law, passing to the Queen's uncle, Ernest, Duke of Cumberland. Hanover was annexed to Prussia in 1866. Edward VII. uses the same coat as Queen Victoria. The present official coat-of-arms of Scotland is quarterly first and fourth Scotland, second England, and third Ireland, within the collar of the Order of the Thistle. Dexter supporter a unicorn and sinister supporter a lion, each holding a spear with the national flags bearing the crosses of St. Andrew and St. George respectively. The crest is a lion sejant affronté on a royal crown, holding in his dexter paw a sword and in his sinister paw a sceptre, and above is a scroll bearing the words "In Defens."

To-night I have only considered the coats-of-arms of our actual sovereigns; I hope, on a future occasion, to have the privilege of telling you something about the coat-of-arms of Royal Consorts, Princes of Wales, and also about the many royal badges.

DISCUSSION.

The CHAIRMAN was sure the members were deeply indebted to Mr. Davenport for his paper and for the beautiful illustrations he had given of the various coats of arms borne by the Sovereigns of this country. With reference to the early connection of England with Aquitaine, it was not uninteresting to observe and it might possibly have some bearing on the arms used by early England, that both Aquitaine and Normandy were formerly represented at the coronations of British Sovereigns by two special officials. Down to quite recent times two persons representing the two Duchies of Normandy and Aquitaine had always taken part in the coronations of British kings. With regard to Edward IV. being the first person to use supporters, he quite accepted the statement that no illustration of such supporters could be found, or was easily to be produced, but that Kings of England did have supporters long anterior to Edward IV. was, he thought, proved by the fact that all the great Earls had supporters. There existed seals of a number of Earls, both of England and Scotland, for a period of a hundred years before Edward IV., and they all had supporters, beautifully engraved. Most of those Seals were supposed to have been made in Italy. With regard to Oliver Cromwell and his very ingenious device, which was no doubt intended to obliterate heraldry as much as possible, the author made one remark from which he (the Chairman) wished to differ, namely, that Oliver Cromwell descended from the Stuarts. The fact was that Oliver Cromwell did descend from a family of Stuarts who lived in the East of England, who attempted to prove and induce certain heralds to record that they descended from the Kings of Scotland; but the whole pedigree was absolutely spurious, and it had been disproved long ago. As regards the heraldry of Queen Anne, he would like to suggest to Mr. Davenport that the arrangement of putting England and Scotland in pale in the first quarter was a beautiful illustration of the accuracy of heraldry, because what really happened in the year 1706 was that both England and Scotland came to an end; they ceased to be separate kingdoms, and from that moment there never was an England and there never had been a Scotland,—they became the kingdom of Great Britain. Therefore, the putting of England and Scotland in pale in the first quarter represented that those two countries were married. Of course, that arrangement could not be continued when a further marriage took place, and therefore, when the union between Great Britain and Ireland occurred it became necessary to go back to the former system of quartering, but the original idea of putting England and Scotland side by side, impaled, was a beautiful illustration of the idea that the two countries were married and had contracted an indissoluble union.

Mr. DAVENPORT, in answer to a suggestion that the "K. H." on one of Henry VIII.'s books stood for Katherine and Henry, said it was a curious question. He had heard the suggestion before, but one reason for his difference of opinion was that he had seen a book of Edward VI.'s with "K. E." upon it which he took to mean "King Edward." Another point was that there were books with "H.A." upon them, being "Henry" and "Anne." He also thought it was unlikely that a king would put his queen's initial before his own.

Captain WILKINSON asked if the author knew anything about the adoption of Edward the Confessor's coat by Richard II. He was rather interested to know how that came about and how long it remained. Edward the Confessor's coat appeared at the back of the Wilton diptych, which was supposed to have been painted about 1377. Holinshed, he thought, mentioned that Richard II. adopted Edward the Confessor's coat, and he would like to know if that coat was adopted later than Richard II.'s time.

Mr. R. L. MORETON remarked that during the recent production of "Richard II." at His Majesty's Theatre, there was a beautiful souvenir distributed, in which there were several remarks about the heraldry in connection with the piece. It was certainly mentioned that Richard was exceedingly fond of King Edward the Confessor's Arms, a cross moline between four silver marquettes, azure. The diptych to which Captain

Wilkinson had referred was, he thought, reproduced in the illustrated edition of Green's Short History.

The CHAIRMAN said that, so far as he personally was concerned, he confessed himself much of a sceptic with regard to the existence of coats of arms of the date of Edward the Confessor. When heraldry became a science, certain coats of arms were attributed to ancient kings; but although he believed that symbolism was used in the sense of a coat of arms as distinguished from a shield at a date long anterior to what was now called heraldry, still he was one of those persons who accepted the proposition that heraldry was introduced with the closed visor; and that when a knight went into battle with his face concealed he used a heraldic symbol on his shield. Every Prince and every so-called King of Wales had a coat of arms; they had coats of arms back to the Maccabees, but he did not believe in them. In conclusion, he desired to propose a most hearty vote of thanks to Mr. Davenport for his interesting paper and beautiful illustrations.

The resolution having been carried unanimously.

Mr. DAVENPORT, in reply, said he had been careful, except with regard to Normandy and Aquitaine, only to show things from the time of Richard I. that could not be questioned. With regard to Oliver Cromwell descending from the Stuarts he was pleased to hear that that was not so, as he never liked to think that Cromwell was a Stuart. He thanked the Chairman for bringing out the interesting point about the impalement of the Coats of England and Scotland.

THE INTERNATIONAL PENITENTIARY CONGRESS.

Sir E. Ruggles-Brise's report on the proceedings of the Seventh International Penitentiary Congress, held at Buda-Pesth, is an interesting and instructive summary of experiments and conclusions bearing upon prison reform, undertaken and arrived at by the leading European States. The word "Penitentiary," which has become the recognised epithet to denote the character of these Congresses, is said to be derived from the Canonical Law of the Middle Ages, prescribing *pénitences*, in the shape of cellular confinement with bread and water as the means of punishment and reformation. It is the idea of punishment as a means of reformation which has now, for more than a century, so powerfully affected the thought and practice of the civilised world, and the question of the adjustment of the machinery of repression to this end is the subject matter of the modern Penitentiary Congress—a sort of International Debating Society, where all States can meet on neutral and non-political ground, merging their nationality in a common humanity. The movement is general throughout the civilised world, and is proceeding on the same lines, and working by the same methods, defined by Sir E. Ruggles-Brise, as follows:—

(*a.*) The co-operation of the State and the individual in the rescue of the waif and stray, the ill-treated, the underfed, and the untaught.

(*b.*) The special treatment in industrial and reformatory schools of vicious and unruly children.

(*c.*) The establishment of children's courts on the models supplied by certain States in America.

(*d.*) The segregation of the "adolescents" from adults—a principle, the importance of which is becoming more and more recognised throughout Europe.

(*e.*) The recognition of the value and importance of the system of probation as a handmaid of the Criminal Law, offering her service under proper guarantees and safeguards, of protection and supervision, with the object of avoiding, in the case of the young and the casual offender, the stigma of imprisonment.

The question, "Does experience point to the desirability of introducing reforms in the institution of trial by jury?" was discussed, and gave rise to much difference of opinion. The confidence which Englishmen repose in the system does not exist to an equal degree on the Continent of Europe. There it was not, as in England, a natural growth corresponding to a natural need and desire for this particular form of jurisdiction, and serving that purpose alone, but a political growth intended for political ends, with the object of extending the power of the people, and completing popular liberty. The system was eloquently defended by Professor Garcon, of the Paris University, and Mr. Choate, the late American Ambassador to England, but it is not regarded with equal favour in Germany, Austria, and Italy. The preference would seem to be for what is known as the *Tribunaux Echevinaux*, or mixed tribunals of professional and lay persons, who would deliberate together, both as to law and fact, and whose decision would be decisive. The Congress did not record any final opinion on the subject.

On the question, "According to what principle, and with what object, should prisoners be classified?" the Congress arrived at the following conclusions:—

1. A classification of persons, according to their morality, is desirable.
2. A classification of the "worst" is the most important, which may be based either on previous record, or on conduct in prison.
3. A classification of the younger prisoners is above all things desirable, and all possible information should be collated with a view of knowing the character, and determining the treatment, of each.

4. The treatment of the "worst" should be more severe, and the efforts of "patronage," or aid-on-discharge, should be specially concentrated upon the young, and upon the prisoners with the better dispositions.

As to the effect of drink on crime, statistics were furnished by Dr. Legrain, of Ville Evrard Asylum, showing the estimated percentage of offences committed as the direct, or indirect consequences of drink in most of the civilised countries of the world. Dr. Madoni, of Louvain (Belgium), as the result of inquiries extending over a period of twenty-two years, during which time he had carefully analysed cases of grave crime, represented the following results:—Of 2,045 men sentenced to not less than five years, 44 per cent. were habitual drunkards, and 11 per cent. were drunk at the moment of the crime. In the case of 130 sentences to *travaux forcés en perpétuité*, the figures were 40 and 54 respectively; of 88 sentenced to death, 45 and 60. M. Marambat, of the Central Prison of Poissy (France), continued, and brought up to date the figures supplied by him, as the result of personal inquiry and analysis, to the Brussels Congress. The examination of some 5 000 cases had then showed a percentage of 66 crimes resulting directly from drink. The further figures now submitted, covering the period 1899-1905 led practically to the same conclusion. The actual figures were as follows:—Various forms of fraud, 64 per cent.; various forms of violence, 83 per cent.; offences against morals, 63 per cent.; offences against Vagrancy Laws, 83 per cent.; arson, 53 per cent. M. Marambat directed his researches also into cases of recidivism within the same period, with the remarkable result that of the total number examined 77 per cent. were old offenders, and of these the same percentage were habitual drunkards.

Sir E. Ruggles-Brise submitted to the Congress papers describing what changes have been instituted, and in what direction, so far as the administration of the prisons of England and Wales are concerned, including a very interesting description of the Borstal scheme, which is based on the necessity for special treatment, on reformatory lines, of all offenders up to the age of 21, on the principle that, up to a certain age, every criminal may be regarded as potentially a good citizen, that his lapse into criminal habits may be due either to physical causes or to bad social environment; that it is the duty of the State at least to try and effect a cure, and not to class the offender off-hand, and without experiment, with the adult professional criminal. But the necessary complement and corner-stone of all reforming work in prisons is a special society or association for the aid and supervision of each case on discharge. This is provided by the "Borstal Association," which has been formed under the patronage of some of the best-known and most distinguished persons in English public life. It is supported by voluntary contributions, and it is to the zeal of this Association (says Sir E Ruggles-Brise) co-operating with the prison authorities, that the very satisfactory and considerable results already obtained are due.

CHINA AS A FIELD FOR PROFESSIONAL MEN.

In response to numerous enquiries regarding China as an inviting field for young men who have entered the professions of law, medicine, and dentistry, the American Consuls in that country have reported at considerable length on the methods and practice that obtain there. There is not much encouragement given in these reports to young men going to China to engage in a profession. While there is always more or less disposition on the part of some young men to push into untried parts of the world, not only for the sake of adventure and experience, but also for a livelihood, the number of enquiries as to opportunities to engage in business, or even to practice the professions, in China seems to indicate that there is rather a well-defined movement to the Far East among some classes. Business opportunities in the Far East are comparatively well understood in their attractive, as well as their unattractive phases. Opportunities for the practice of the professions, however, are comparatively unknown. In some lines of professional work there are well-defined limits of prosperity and adversity, but in others the result of Anglo-Saxon effort is yet to be shown. One reason for a movement among young men to come to the Far East to practice the professions lies in the reports which they have received of exceptional opportunities enjoyed by other men, of the good fortune of some men in building up large business connections, and of the earnings of large fees by men in practice in China. That large fees have been earned in medicine, law, dentistry, and otherwise is to be freely admitted. It does not follow, however, that all practitioners in China can earn fees of this kind, or that the opportunity will come any oftener than it does at home. If it were true, which it probably is not, that the average earnings of professional men in China are greater than they are at home, it is to be considered that increased cost of living, increased expenses for books, medicines and supplies, and the absence of other things which go to make life worth living, may combine to render practice in China less profitable and satisfactory in the long run than practice in Europe and America. Nor has the young professional man any better chance of work or advancement than he has at home. There are three professions which are attracting the attention and engaging the abilities of foreigners in China at the present time—those of the law, medicine, and its kindred profession, dentistry. The Chinese people have had all three of these professions for ages, but their practice has been far different from the practice in other lands, and it will be some time before

Chinese competition in any of them will be felt except through foreign training and as a result of the efforts of foreigners. Chinese medical men have not been held in very high estimation among their own people for many years. Chinese dentists have done more than their fellows in the medical line, and all things considered Chinese dentistry, while it cannot compare with modern dentistry as practised in Europe and America, is far above what might have been expected, taking into consideration the position of other sciences in China. With regard to the law, the practice in China is entirely different from that in Europe and the United States. There is some opportunity for outside lawyers in the Consular Courts, where administration is based upon the laws and procedure of the country of each consulate, and which affects foreigners in their own relations and disputes between Chinese citizens and foreigners. There are no requirements for admission to the bar in China for the reason that there is no bar. Each consular court has its rules for admission, and when an attorney is allowed to practice in one court it is taken as an international discrimination if any other consular court does not extend the like courtesy. There should be no false idea, however, that the attorneys practising law in China are making immense fortunes, or that there is much of an opening for other lawyers in this field. There will doubtless be an increase in the law business in China as foreign interests increase, but it is very doubtful indeed if this increase will keep ahead of the natural increase in the number of practising lawyers. There is but a limited field for the law in China at best, and most of the field is already occupied by men who are well established, and, in the opinion of the American Consuls, there is little to encourage a young man entering upon the practice of law in a Chinese port. Unless he is able to purchase a share in an old-established business, his struggle for work will probably be quite as keen as it would be at home, and he has neither the field to work in nor matters to guide him and protect him from mistakes as he has at home.

With regard to medicine, its practice is confined to the work of physicians not connected with a missionary society, generally called "community doctors," and to those who are connected with missionary societies. There is a considerable difference in the nature of the practice of these two classes of doctors, although medical men of each class may be of the best standing professionally. Missionary doctors, as a rule, are under contract with their societies either not to undertake any work outside their missionary duties, or, more generally, to turn over to their societies all fees derived from practice of all kinds within or without their missionary duties. The Imperial Maritime Customs Service has doctors connected with the staff of each port, whose duties are to look after the health of members of the staff, and to attend to the medical needs and the inspection of vessels visiting the ports. Sometimes these port doctors are missionary doctors as well. The number of native practitioners with foreign training is rapidly increasing. Practically, every missionary doctor in China has a medical school for natives. The result is that in due time the leaven of foreign medical knowledge will have lightened the whole mass of Chinese medical ignorance, and it is probable that, long before China is ready to accept foreign ideas generally, it will be able to care for itself in a medical way. At present the amount of unrelieved suffering which could be relieved under proper medical care is appalling. It is one of the first things noted by foreigners coming to China, and it is one of the last things they forget. It will be some time before China can educate enough of its own people to take care of this vast mass of humanity; but the work is being accomplished, and foreign medicine is favourably received by the people as a whole. The Chinese are favourable to the patent medicine business if it can be brought within their reach. They take naturally to such a method of treating diseases, and remedies advertised as they are in Europe and America would have a very large sale, provided the prices charged for them were within the reach of the middle classes. The lower classes are generally too poor to buy any remedy or have the services of any doctor unless they are given to them free. They suffer simply because it is cheaper than to be cured. With regard to dentistry all persons familiar with the situation seem to agree that, owing to a number of reasons, opportunities for the successful practice of dentistry are extremely limited. It is the opinion of one who has had experience that a dentist settling in China unless willing to buy an established practice, or work as an assistant, either for salary or on commission, will find it impossible to pay expenses in a shorter time than two years. He found that the mass of Chinese are unable to pay fees which would justify his working among them, and the moneyed individual ordinarily goes to the long established practitioner. The British people, who, of course, largely preponderate among foreigners in the East, are averse to changes. They go to a certain dentist because they have been there before, or because their fathers went to that dentist, or his predecessor before them. Of the other nationalities the German is prone to patronise his own countrymen. From personal observation, he adds: "I should say that there is not a dentist in China or Japan who can add to his bank balance from dentistry alone the sum of £300 in one year. As his practice increases, his social obligations and, consequently, his expenses increase in proportion." Foreign trained Japanese are becoming a very important factor in the professional situation in China, and in dentistry particularly, their influence is being felt by foreign practitioners. They are often well trained, and they work for fees which a foreign dentist cannot afford to accept. They have also the advantage in general practice of understanding the Chinese, and

of readily acquiring enough of the language materially to aid them in their work. China has yet to recognise the part that professions have to play in its national life. The ancient practice of medicine and dentistry never was very favourably regarded, although the necessity of their existence was understood. Chinese practice, as such, is rapidly disappearing, and its devotees are looked upon by intelligent Chinese as mere quacks. The Chinese are taking to medicine and dentistry, and even to the law, not because they regard them favourably, perhaps, but from sheer necessity. If the doctor or dentist cannot effect a cure in every instance he is immediately placed upon the defensive. With the lawyer, it is a case of consulting him only in desperate straits. The Chinese have no appreciation of professionalism as such, no appreciation of the part the professions take in the development of national life, and nothing more, at best, than an appreciation of them as a temporary help in time of trouble.

THE PROGRESS OF CANADA.

The Report of the Department of Trade and Commerce (Ottawa) for the fiscal year ended June 30, 1905, supplemented by the Universal Statement for the succeeding six months to December 31, shows that, if the great advance of 1904-5 has not been fully maintained, yet the total trade has fallen below the highest point reached in the history of the Dominion, say 2,500,000 dols.; whilst, so far as the imports are concerned, there has been an increase, in round numbers, of 7,600,000 dols. Figures bearing upon the progress of the country are not, of course, confined to imports and exports. There are others of equal significance, notably those referring to banking —including circulation, deposits, loans, clearing-house returns, &c., insurance, State Office statistics, railways, shipping canals; and Tables given in this Report (first issued in connection with the Department's annual report) show how the general advance in the figures has kept pace with the aggregate trade, as shown in the Tables of imports and exports, all, with only one exception, having practically doubled— and in some instances far more than doubled—in the last ten years, the one exception being the number of failures reported, with relative liabilities, which during the year 1905 shows only 63½ per cent. in number, and 57½ per cent. in liabilities, of those of 1896.

But whilst the figures relating to the progress of Canada testify to the wonderful development of the country, those relating to the trade of the Mother Country with the Dominion are less satisfactory. Whilst the imports from France increased from 5,345,902 dols. in 1904 to 7,058,743 dols. in 1905, and from the United States from 143,010,578 dols. to 152,431,626 dols., those from the United Kingdom actually fell off from 61,724,616 dols. to 60.342,704 dols. How greatly the position has altered in recent years in favour of the United States will be seen from the following figures, which give the total imports from the two countries and the percentages :—

Imports from the United Kingdom and United States.

	U.K.		U.S.
1895..	$31,059,332	..	$50,179,004
	30·85 per cent.	..	49·84 per cent.
1900..	$44,279,983	..	$102,080,177
	25·66 per cent.	..	59·17 per cent.
1904..	$61,724,616	..	$143,010,578
	25·34 per cent.	..	58·71 per cent.
1905..	$60,342,704	..	$152,431,626
	23·98 per cent.	..	60·58 per cent.

The figures show that in the last ten years, and notwithstanding the augmented tariff, the percentage of the total imports of the Dominion received from the Mother Country has fallen from 30·85 per cent. to 23·98 per cent., whereas those from the United States have risen from 49·84 per cent. to 60·58 per cent. And if the imports are divided into dutiable and free it will be found that during the same period the dutiable imports from the United Kingdom have fallen from 39·81 per cent. to 29·88 per cent., whilst those from the United States have increased in the same period from 44·05 per cent. to 52·21 per cent. Actually in goods coming in under the 33 per cent. preferential tariff, the United Kingdom has done much worse when compared with the United States, the one losing 10 per cent. and the other gaining 8 per cent. In free imports the United Kingdom fell only from 18·39 per cent. to 15·14 per cent., the United States rising from 57·79 to 73·13 per cent.

If exports are taken, the figures are more favourable to the United Kingdom, but the American proportionate advance remains much greater. Thus, in 1895, the total exports of Canada to Great Britain amounted to 61,856,890 dols., or 58·35 per cent. ; in 1905 they had increased to 101,951,771 dols., but the percentage had fallen to 50·61 per cent. On the other hand, the total exports to the United States in 1895 were 34,164,567 dols., and had increased in 1905 to 75,563,015 dols., the percentage to the total exports having risen from 32·22 per cent. to 37·51 per cent. If the exports to the United Kingdom are analysed it will be found that whilst, taking the last five years, the aggregate increase is large, it is less under important heads than might have been expected.

Exports from Canada to the United Kingdom.

	1901. dols.		1903. dols.		1905. dols.
Grain	22,913,690	...	31,180,778	...	14,604,514
Salmon (canned) ...	2,322,111	...	2,459,499	...	1,333,858
Apples	1,422,665	...	2,696,937	...	2,513,599
Butter	3,197,839	...	6,554,014	...	5,580,354
Cheese............... ..	21,033,131	...	24,653,404	...	20,190,447
Eggs.....................	1,677,727	...	1,420,760	...	660,610
Bacon and hams ...	11,733,013	...	15,873,739	...	12,505,652
Canned meats	357,047	...	5,595,072	...	3,525,270
Meats, all other, and lard...........	1,348,795	...	574,241	...	338,2
Wood, and manufactures of.........	17,556,825	...	18,824,525	...	13,605, 08

It will be seen that in the majority of items there was actual decrease in 1905 as compared with 1900, the only items in which there was large increase being canned meats and butter, neutralised to some extent by the heavy fall in all other kinds of meats of over a million of dollars. Grain, timber, woods of all kinds show heavy decreases.

It cannot be said that the figures quoted above are quite satisfactory to British trade. It is true that exports from the United Kingdom to Canada have very nearly doubled in the five years 1900-5, but the percentage has fallan from 50·85 to 23·98, whereas the exports from the United States have more than trebled, and the percentage has risen from 45·84 to 60·58. The competition is between this country and the United States. So far as other countries are concerned, their share of the Canadian market is small. It is possible for Great Britain to recover her position as compared with the United States. Clearly the preferential tariff has not done more than check the British decline. That decline must have been large, perhaps much larger if there had been no preference, but the preference has not stopped the steady advance of the American exports. Where is the explanation to be looked for? Mr. O'Hara, of the Ottawa Board of Trade, says the failure of the British exporter to hold his own is largely due to Great Britain having no commercial agents in Canada, and the Chairman of the Canadian Pacific Railway Company says much the same thing when he complains that the British exporter does not study the Canadian market. There must be substance in these contentions. But it must be remembered that Canadian imports from the United States are also increasing, both in amount and proportion at a greater rate than the imports from Great Britain, and the lack of British commercial agents in Canada can have nothing to do with that. The main difficulty in the way of our holding our own against the United States is no doubt the geographical one. Canadian produces herself the great primary industries, and the products of the secondary industries she can get quicker from the United States. "Quick delivery," writes Mr. John Morgan, in a recent letter, "will secure the business, even though the price is $7\frac{1}{2}$ per cent. to 10 per cent. higher, and it must always be remembered that the freight (say) from Birmingham to Ottawa in many cases exceeds the freight from the States by more than the amount of the preference duty." It is possible to telegraph an order to New York at small expense and get the goods in three days. A Canadian importer has to allow about five weeks for getting goods from Birmingham. He therefore suggests the summoning a conference of the eight railway companies, the steamship lines, and the Canadian railway authorities to arrange for through bills of lading on small consignments from the principal centres in Great Britain to the Canadian cities and for prompt delivery at low rates. In this way he thinks much of the business which has gone to America, by reason of geographical position, and the consequent wasting of time and freight, might be secured by British firms.

THE DEVELOPMENT OF FORMOSA BY JAPAN.

Formosa, which was subjected to military government for a short time after its transfer from the control of China to that of Japan, was in 1896 given a civil government directed by the Government of Japan. A single great military expedition sent throughout the island terminated hostilities among the natives, except as to the small element known as the "Head Hunters" in the inaccessible forests of the interior, who will probably submit only when their haunts are invaded through the spread of cultivation. The foremost requisite to effective control was communication. Thus far about 1,200 miles of roads have been built. A line of railway 232 miles long was constructed from near the southern to the northern extremity of the island, being opened to traffic throughout its length on May 15th, 1905. Post-offices were established, their number in 1903-4 being 117, with 7,608 miles of postal routes. The number of letters, &c., dealt with was 13,792,000 in 1903-4 against 5,237,000 in 1896-7. In 1903-4 the telegraph line, 908 miles long, delivered 1,027,471 messages, while the telephone line, 307 miles long, delivered 3,578,267 messages. According to official reports recently issued by the Japanese Government, education received immediate attention in Formosa. The educational system is divided into three departments according to the three classes of the population—(1) Japanese immigrants, 42,125; (2) Chinese settlers and their descendants, 2,788,633; (3) Malay aborigines, 94,315. For the Japanese immigrants 60 teachers are provided, whose pupils in 1904 numbered about 2,000. The Chinese have 130 schools with 521 teachers and about 18,000 pupils. Besides these there are about 1,800 "family schools" of the old style, with some 32,000 pupils. The medical school at Taihoku, with instruction conducted in Japanese, has 130 students with a five-year course. The National Language School is intended to teach Japanese children, and it also comprises a technical course. The normal school trains native youths as teachers of native primary schools. Five main schools and eleven branch schools have been established for the aborigines. In addition to these there are missionary schools, both Christian and Buddhist, as well as a museum and library.

Hygiene received immediate and careful attention. Numerous artesian wells were provided, supplying pure drinking water for the inhabitants, more than 800 such wells being situated in the district of Taihoku, which comprises about one-tenth of the population. In the capital of that district extensive waterworks were built. Sewerage was introduced in a number of

cities. Nine large towns have hospitals, many smaller places have branch establishments of that kind, and more than two hundred medical men are practising on the island. The number of deaths from the plague fell from 2,619 in the first half of 1901, to 606 in the same period of 1903.

The natural resources of the island are so great that the introduction of an enlightened and energetic government seems likely to result in a vast increase of production. The production of rice increased from 21,300,000 bushels in 1900 to 36,500,000 bushels in 1903. In sugar there has been an increase from 63,767,000 pounds in 1900 to 110,125,000 pounds in 1904; in sweet potatoes from 456,625,000 pounds in 1900, to 1,194,000,000 pounds in 1903. Ramie and jute production also increased, but the yield of tea fell off. The production of gold increased from 11,140 ounces in 1900, to 26,635 ounces in 1903; gold dust from 1,142 ounces in 1900 to 19,410 ounces in 1902, falling, however, to 9,188 ounces in 1903. Coal and sulphur also increased. The principal industrial products are camphor and camphor oil. These are of special interest, because Formosa is the world's chief purveyor of camphor. Camphor production declined from 4,627,000 pounds in 1900, to 4,508,000 pounds in 1904, while camphor oil increased from 3,142,000 pounds in 1900, to 3,618,000 pounds in 1904. The wasteful methods used in the industry led the Government in 1899 to declare it a State monopoly. This put a limit on production as to season and locality, and in the number of trees to be felled. The refiners are obliged to sell their half finished product to the Government, which in turns sells most of it to a monopoly agent, at present a British firm. The native process of refining has been entirely superseded by the Japanese process. The difference between the two may be illustrated by the fact that the camphor oil, almost equal in importance to the camphor itself, was formerly allowed to go to waste. It is estimated that at the present rate of consumption, the camphor trees now on the island would last forty or fifty years. The Government has already taken measures to secure a permanent supply by planting millions of young camphor trees.

Trade between Japan and Formosa has, in recent years, been growing with great rapidity, while trade between Formosa and foreign countries has remained practically stationary. In 1898 the exports to Japan were valued at £328,000; in 1904, these were £1,063,000. The imports from Japan, in 1898, were £469,060; in 1904. £1,036,000. To foreign countries the exports in 1898 were £1,253,000, while the imports from foreign countries were £1,721,000; in 1904, the exports from Formosa to foreign countries were £1,264,000, while the imports from foreign countries were £1,310,000. In exports from Formosa the order of importance of the various countries in 1904 was as follows:—China, United States, Hong-Kong, United Kingdom, and Germany. As regards the imports the order was as follows:—China, British India, United States, United Kingdom, Hong-Kong, Asiatic Russia, and Germany. The principal commodities exported from Formosa in 1904 were black tea, rice, sugar, camphor, turmeric, flax, hemp, and jute, and coal. The chief imports consisted of opium, petroleum, rice, timber and boards, cotton goods, flour, sugar, Chinese paper, and swine.

RECENT ACQUISITIONS IN THE VICTORIA AND ALBERT MUSEUM, SOUTH KENSINGTON.

The Museum has recently purchased a pair of candlesticks of cast brass of the 17th century, decorated with floral designs on a black and white ground. They have very large circular plates between the stems and the bases, which seem to have been a characteristic feature of the period. There are two plain candlesticks of brass of this type in the Museum, and in the Kremlin at Moscow there is a very large specimen in hammered silver gilt bearing the English Hall-mark for 1663-4. These candlesticks are exhibited with the other English enamelled objects in the Prince Consort's Gallery.

In two of the cases opposite the Leighton fresco of the Arts of Peace is a small collection of drawings, in black and white, by G. J. Pinwell and J. W. North, A.R.A. They were prepared for the most part to illustrate the "Poems by Jean Ingelow," published by Messrs. Longmans in 1867. With them is shown a very interesting pen and pencil drawing by T. White of Pinwell himself at work; it is dated 1862.

In an adjoining case are some wood-blocks, upon which F. Walker, G. Du Maurier, Miss Edwards, Linley Sambourne, and H. Furniss have drawn, but which have in some cases never been engraved. No print from the large cut block by Pinwell was ever published.

Five cases near the door of the Art Library contain a large collection of illustrated printed books on architecture, chiefly of the 16th century.

In the Architectural Court is the recently acquired cast of the bronze monument of Archbishop Ernst of Magdegurg (1464-1513), executed by Peter Vischer in 1497, six years before the prelate's death.

Some important additions have been made to the collections of architectural details in carved stone, through the generosity of Mr. J. H. Fitzhenry, who has presented four examples of French origin, dating from the time of Francis I. (1515-1547). They are exhibited at the north-west corner of the North Court. The most striking of them is a complete dormer window, standing some 20 feet high, from the Château de Montal, a ruined manor house situated on the high ground overlooking St. Céré, in the Department of Lot. This château was built for Jehane de Belsac, dame de Montal, and was begun in 1523; it is thus contemporaneous with the better-known edifices at Blois and Chambord.

It was from one of these dormer windows—

perhaps from this very one—that, as the story goes, Rose de Montal, forsaken by her lover, Roger de Castelnau, flung herself with the cry "Plus d'espoir"—a motto which is engraved on the pediment of the window now in the museum. The sculptured ornament includes a beautiful frieze of scrolls, demi-figures, and amorini disposed symmetrically on either side of a central cartouche; on the pediment, besides the inscription, are two projecting busts and the figure of a headless warrior holding his skull in his hand. The arms of Montal and Balsac are carved below.

Next to it is the upper part of a similar dormer window, evidently dating from the same period, as the crowned salamander in flames, which forms so striking a piece of ornament on this pediment, was a favourite device of Francis I.

Below is placed a portion of an arch-soffit from the Château de Bonnivat, situated some twenty miles from Poitiers, and built by Guillaume de Gouffier, Amiral de Bonnivat, a favourite of the same king.

The fourth example is a canopy for a statuette formerly in the church of St. Etienne du Mont, at Paris. It is composed of delicate Renaissance work, betraying in its disposition traces of the Gothic style, which even at that period were still apparent in French architecture. It is enriched with beautifully-modelled figures, scrolls, and shields of arms. Replicas of these shields may still be seen on the tall columns and brackets at the back of the high altar at St. Etienne.

COTTON-GROWING IN GERMAN COLONIES.

The steps taken and the progress made in the development of cotton production by the German Government have assumed such importance that they merit a place in a review of industrial subjects. There can no longer be a doubt that there is a determined and united effort on the part of German manufacturers of cotton goods to devise some means of becoming independent of the American cotton supply. The American consul at Zittau says that the gambling fluctuation in raw cotton is so great, and the speculative manipulation has introduced such an element of uncertainty into the conditions of manufacture, that the agitation seems to be general in Europe to devise some means of independence from what is termed "the intolerable yoke of the American speculator." Relative to the progress made in German colonial cotton-growing, an interesting report has recently been made by Herr Karl Supf, president of the Colonial Committee of Economics. In speaking of the different colonies, Herr Supf said that in Togo, since the report of the spring of 1905, cotton cultivation has developed in normal proportions. During the planting time—June and July—there was much inquiry for seed in all districts. In order to cheapen the cost of production, an earlier sowing of maize and pea-nuts was made, the waste of these plants being afterwards used as fertilisers. From the harvest of 1904-5, 500 bales of 500 pounds each have been shipped up to the present from the port of Lome to Germany. Transport to the coast is rendered very difficult. From the districts of Kpando and Kete Kratyi the cotton is sent to the port of Adda, *viâ* the river Volta, for shipment. Permission is to be asked of the Reichstag to extend the railway from Lome to Palime (76 miles), which at present only runs to Noeppe (17 to 18 miles). Judging from experiments made in Lagos, Dahomey, and Togo, the chances of success in cotton culture are increased on the palm oil belt, first from the fact that the rainfalls are infrequent, and the possibility of keeping cattle, and secondly, because no other native product is cultivated. The estimated harvest in the Atakpame district is 200 bales of 500 lbs., and the Sakode district is an especially promising cotton country. The well populated northern districts are able to produce, besides cotton, india-rubber, maize, and rice in great quantities, but the development of the districts cannot at present be undertaken as there are no transport facilities. In the interests of increased cotton culture the committee is now trying to obtain reliable information as to the paying prospects of an extension of the interior railway from Palime to Atakpame, about 56 miles. Speaking further of the German East African Colony, Herr Supf stated that about 1,000 bales of 500 lbs. of the 1904 harvest have been shipped from its ports. Cotton grown in the districts of the Victoria Nyanza Lake and the Kilima-Njaro Mountains is conveyed by the Uganda Railway to the port of shipment, Mombasa. This colony is greatly increasing its cotton area. An estimate of the autumn (1905) harvest in this colony is not possible on account of the rebellion, but according to reports the various communities of the colony kept up their orders for seed for the season, January-March, 1906. As in Togo, the committee is endeavouring to place the ginning stations in the hands of firms established in the colony, and to persuade them to buy the raw product. The German Press has stated that one of the causes for the native rising is the means employed for the persuasion of the people to undertake the cultivation of cotton. From the Cameroons the first large sample shipment, 22 bales from the Bamum district were forwarded in July, 1905, to two large cotton spinners in Leipzig and Chemnitz. The result of these tests shows that this cotton can be used as a substitute for the American low middling only. It is proposed that a cotton expert shall undertake a journey in the Bamum and Bali States, in order to make arrangements with the native chiefs for supplying seed, hand gins, presses, &c., free of charge, with a view of introducing a rational cultivation and harvesting. The export capacity of the Bamum and Bali States will largely depend on the construction of a railway connecting these districts with the coast.

HOME INDUSTRIES.

Irregular Shipments.—There are many complaints of the irregularity of Canadian shipments. For example, Mr. P. B. Ball, Commercial Agent of the Dominion Government to Birmingham, says that, in interviewing numbers of importers of Canadian products, such as flour dealers, oatmeal dealers, and others, he finds much feeling as to the manner in which the shipments are made in Canada, more especially their irregularity. It seems that it particularly affects shipments from Canadian ports, such as Montreal. When all the ports are open it is not the same, but it is particularly noticeable when Montreal opens up in the spring, and the railroad agents are all trying to make contracts to ship *viâ* Montreal. Large contracts are entered into, and shippers forward their goods. One lot may be shipped at once, and will probably reach its destination in a month; but sometimes it happens that there is a rush of goods, and they do not reach their destination under three months, and sometimes longer. Unless the Canadian exporter can guarantee a greatly reduced period of time between shipment and arrival shipments must be very seriously affected. Among the causes of these irregularities in transport appear to be the practice of putting the first goods arriving into the warehouse. If the ship is filled by later arrivals, the goods first received remain behind, and new goods coming in continually may be packed on them, instead of there being a routine method of "first come, first served." Again, it is said that sellers in Canada, directly they receive an order, instead of seeing the goods promptly put on rail and rushed to the steamers at seaboard, put them on rail, write a bill of lading, and sign and date at the time, instead of seeing them put on board and then signing it. The result is that the goods are hung up somewhere, and frequently the draft matures before the goods leave Canada. It would seem desirable to give attention to the complaints of delayed and irregular delivery of goods. No doubt there is exaggeration in them, but enough is admitted to show there is ground of complaint.

The Electrical Industry.—In an interesting paper on the British electrical industry, Mr. Garcke gives some figures showing the progress made in this country in recent years in the industry, as a whole, and in the supply of electricity. The aggregate capital expended on electricity supply undertakings by municipalities and companies in 1895 was £7,800,000; in 1905 it had risen to £67,587,000. The average capital expenditure worked out at about £100 per kilowatt of plant, and £50 per kilowatt of plant installed was regarded as a very low record. In 1905 the average capital expenditure per kilowatt installed works out at about £81. The lamps connected were 2,000,000 in 1895, and 24,000,000 in 1905; the Board of Trade units sold were, respectively, 30,200,000 and 533,600,000, and the average prices per unit obtained were 5·7d. and 2·7d., respectively. In 1895 the greatest output at one station was about $5\frac{1}{2}$ million units, while last year one station recorded an output exceeding $33\frac{1}{2}$ million units. In a paper on the cost of generation and distribution of electrical energy, read by Mr. Robert Hammond before the Institute of Electrical Engineers in March, 1898, the ideal cost per unit at a power-house hypothetically combining all the best conditions known at the time, was given as follows: Fuel, ·25d.: oil, waste, water, &c., ·05d; wages, ·20d.; repairs, ·06d.; rent, rates, and taxes, ·06d.; management, ·22d.; total, ·84d. per unit. A similar table prepared in the 1905 returns gives the following compilation of best records: Fuel, ·19d. per unit; oil, waste, water, &c., ·01d.; wages, ·07d.; repairs, .04d.; rent, rates, and taxes, ·02d.; management, ·08d.; total, ·41d. The 1881 Electrical Exhibition at the Crystal Palace might be said to have started active speculation in electricity, and between 1881 and 1883 electrical supply companies with a total capital of £16,000,000 were registered; but the Electric Light Act 1882, with its short tenure, and purchase conditions, injured the industry for several years. The Amending Act of 1888 doubled the period of tenure, and was followed by a vigorous revival; and since then, and notwithstanding remaining and serious restrictions, the industry, as shown by the figures given above, has expanded rapidly. Result of production on a large scale by power stations whose stations are situate in the most favourable positions, and able to distribute electrical energy by high tension over large areas must be great economies which will give further and big impetus to the electrical industry.

Electric Tramways and Motor Omnibuses.—With new motor companies coming out almost every week, and appealing to the public for large subscriptions, investors would do well to acquaint themselves with the points in favour of and against each form of locomotion. Is the motor omnibus likely to supersede, or seriously injure, the electric tramway? Prediction would be valueless, but the advantages and drawbacks of each method may be usefully considered. The advantages of the motor omnibus are greater speed from point to point, ability to vary the service from one road to another and to draw up by the pavement, absence of rails in the roadway, and non-interference with other vehicles. The disadvantages are high cost of operation, great noise, smell, side slip, danger of fire, vibration, danger to other vehicle users, and unreliability. The advantages of the electric tramways may be said to be, lowest known costs of operation, great comfort, cleanliness, and good lighting, comparative absence of noise and vibration, reliability, absence of danger of fire and side slip, improvement of the roadway; the disadvantages are—running on rails, need of passengers to go to the middle of the road, the fact that rails are objectionable to other traffic, and in narrow roads interfere with other vehicles desiring to stop by the

pavement. It must, however, be remembered that, whilst it will not be easy to improve upon the present electric tramcar, motor omnibuses are in their infancy, and it is reasonable to assume that in no long time the cost of working them will be greatly reduced, and the danger of fire and side-slip lessened, if not entirely removed. It may be taken that the motor omnibus has a great future before it as the feeder of the tramway, and where the traffic would not justify a tramway. Fairly capitalised and well managed, the electric tramway can be worked at a surprisingly cheap rate. The balance-sheet of the Leicester Corporation Tramways for 1905 shows that the total cost of operation in that town, including repairs and maintenance, worked out at 4·583d. per car mile, which showed a profit of 0·17d. per car mile. And where the cars are run under much less favourable conditions, even at a loss, there is no thought of removing the tram rails.

"*Welfare Work*."—The movement in the United States, to which the title of "Welfare Work" has been given, deserves, as it is no doubt receiving, the careful attention of employers in this country. It is an attempt to coalesce the discordant elements of Capital and Labour, by the infusion of a humane spirit into the industrial atmosphere. Philanthropy has nothing to do with it. It is an effort of the employer and the *employé* to co-operate for the benefit of each other, and to bring about mutual good will. Just as on a well managed sugar estate, worked by slaves in the days gone by, the sagacious manager was careful of the health of his slaves, because healthy slaves were more profitable than sickly ones, so American employers are moved to "welfare work" by the belief that the welfare of *employés* as a trade item of expense is as necessary for the proper management of extensive works as are the items set aside for depreciation of machinery and other purposes. There are, of course, model works in this country, but here the development of co-operation on broad and well defined lines has been left to the initiative of isolated firms. In the United States it is already far beyond that stage. Under the auspices of an organisation known as the National Civic Federation it is spreading far and wide. A firm that undertakes "welfare work" starts by creating an entirely new department of the business. At the head of it is installed a welfare manager, many of whose duties are similar to the social work undertaken by the parish priest in poor localities. This is how these duties are described, as explained by a correspondent of *The Times*:—"Taking no part in the conduct of the business itself, his more practical duties are directed to seeing that the works themselves are kept in as fit a condition as the men, solely in order that the latter may perform their duties at their highest efficiency. Perfect sanitary and hygienic conditions, proper lighting, the removal of structural inconveniences, and the remedying of the many minor physical discomforts and hindrances which clog the wheels of the human machinery—they are his proper concern. He has also a keen eye on the proper feeding of his *protégés*, for a cheap, clean restaurant within the walls is one of the most important features of welfare work. Under his management a 'model' manufacturing community slowly develops, in which the *employés* enjoy many of the social amenities and institutions of an ideal township. The head of the business practices betterment as a part of the day's work, and acknowledges no claim to credit for it. The American view is that this work is more within the compass of great manufacturing firms who employ a large assortment of lads than in that of charitable, or semi-religious bodies, or even of manufacturers.

Employers and Employed in England.—That the system is spreading rapidly in the United States is not open to doubt; whether it will ever do so here remains to be seen. Social conditions in America are more favourable to closer relations between master and man than they are here; but here, as in America, employers know the difference between earnest and lagging work, and if they see that "welfare work" conduces to it, they may be expected in time to adopt it. Nor is it easy to see upon what ground the workman could object to it whilst it remains free of any claim upon his gratitude. It may be recalled that the Mosley Industrial Commission was very favourably impressed with the work of the National Civic Federation, and all members of the Commission who were present in New York at the time the subject was ventilated signed a document expressing their desire to see some similar organisation in England. They were especially impressed with the section of the Federation whose duty it is to get information of the first sign of impending trouble, and in the earliest stages of a dispute to step in for the purpose of bringing the contending parties together at a round table conference before any breach has actually taken place, and before either side have assumed a position from which it can recede only with difficulty. The objects of the National Civic Federation must meet with sound approval. Whether it is possible to work to any large extent on similar lines here time will tell.

The Trade Marks' Act.—The Amending Trade Marks' Act, introduced and carried through the House of Commons last session by Lord Justice (then Mr.) Fletcher Moulton, came into operation on April 11, and under its provisions there should be much less difficulty than there has been in securing the registration of trade marks. The definition of a trade mark has been made wider, and, among other things, the new Act allows of registration of "special trade marks,"—that is, marks belonging to persons or associations, and stamped on or attached to goods as a certificate that such goods have been examined, or tested, by the owners of the marks. For example, the "hall marks" stamped

on silver may now be registered as trade marks; but such "special trade marks" can only be assigned by permission of the Board of Trade. Again, under the old Acts, the Courts have refused registration of a word because in minute analysis a connection could be shown between the word aud the character of the goods to which it referred, though such connection did not at once suggest itself. To prevent this the word "direct" is now introduced, so that, unless the word has obviously "a direct influence" to the goods to which it is attached it may be registered. It is to be hoped that the Judges will take a broader view of the intentions of the Act than has been sometimes the case in their reading of the old one.

CORRESPONDENCE.

MOND GAS AND POWER TRANSMISSION.

Referring to Mr. Emile S. Mond's communication to the *Journal* of 13th inst., while I appreciate his willingness to furnish me with information as to the cost of manufacture and transmission of gas, his statement of the former does not materially affect the comparative Table of Mond gas and coal-gas which he calls in question. He appears to be under the impression that the costs given in this Table are intended as the lowest costs of the respective gases. This is not the case. The object of my paper being to show the economy of gas as a medium for the transmission of power, I did not feel justified in taking it at its lowest cost, but preferred to use figures which left a substantial margin against myself. The cost given for coal-gas is, as stated, an actual cost, and I understand that Mond gas also is actually made at or about the figure which I have assumed for it. The cost of the coal from which the coal-gas was made was 8s. 4¾d. per ton, and it would obviously have been unfair to compare, as Mr. Mond suggests, the cost of this gas with that of Mond gas made from coal at 6s. or 3s. 6d. He tells us that, with coal at the latter price and sulphate of ammonia at £12 . 10s. per ton, "the by-products more than pay for the actual cost of the gas, and leave a considerable sum over towards the cost of compression and transmission." This is certainly a striking illustration both of the value of the Mond process and the economy of gaseous fuel; but if we give coal-gas also the benefit of coal at 3s. 6d., the by-products will not only pay for the gas, but will defray the entire cost of compression and transmission, and leave something over towards interest and depreciation on the cost of the manufacturing plant. The adoption of Mr. Mond's basis, therefore, does not displace coal-gas from its position as the more economical medium for long-distance transmission. It should not be overlooked that these negative costs are contingent on a supply of bituminous slack at 3s. 6d. per ton; and, while accepting Mr. Mond's statement that slack can be had at this price at the present time, I am not satisfied that this would continue to be the case if gas were generally used in place of coal.

I trust that it is not necessary to add that the foregoing remarks do not imply any disparagement of the Mond process, the value of which, both from a coal-user's and a national point of view, must be apparent to all. I may further point out that the case dealt with in my paper, involving as it does a distance of 173 miles, is the most unfavourable to Mond gas, and that for shorter distances the disadvantage due to the bulk of the latter becomes proportionately less.

ARTHUR J. MARTIN.

7, Victoria-street, Westminster, S.W.,
April 18, 1906.

OBITUARY.

RICHARD GARNETT, C.B., LL.D.—Dr. Garnett, the eminent bibliographer, died at his residence in Hampstead, on Good Friday, 13th inst., from internal hæmorrhage. He was born at Lichfield on the 27th February, 1835, where his father, the Rev. Richard Garnett, a distinguished philologist, was priest vicar of Lichfield Cathedral. Soon afterwards, Mr. Garnett, Senior, was appointed Assistant Keeper of Printed Books at the British Museum, in succession to the Rev. Henry Cary, translator of Dante, whose marble bust is in the great room of the British Museum Library. The young Richard Garnett was appointed an assistant in the British Museum Library in 1851, shortly after his father's death. He became Superintendent of the Reading Room in 1875; and here his enormous knowledge of books, which was not merely curious but thoroughly practical and ready for immediate use, was of immense value to all readers, and was readily accorded to everyone who applied to him for information. From 1890 to 1899 he was Keeper of the Printed Books, and to him the public largely owe the great privilege of obtaining a printed catalogue to the enormous Library of the British Museum. For many years there was a generally expressed opinion by the authorities that a MS. catalogue was preferable to a printed catalogue, but he was always a strong advocate for the latter, and in spite of enormous difficulties he succeeded in bringing this great work to completion in an unprecedentedly short period of time.

A most interesting book, entitled "Three Hundred Notable Books added to the Library of the British Museum under the Keepership of Richard Garnett, 1890–1899," was privately printed by his friends and colleagues, Mr. Pollard and the late Mr. Proctor, on his retirement from the Museum.

Dr. Garnett was a Trustee of the National Portrait Gallery and held the office of President of the Library Association, the Bibliographical Society, and the Hampstead Antiquarian Society. He was an excellent chairman, for, however unpromising the subject of discussion, he was always able to bring forward from the most out-of-the-way sources something of value to illustrate the subject. He was a voluminous author and translator—from his first book "Primula: Book of Lyrics" in 1858 to his "Essays of an ex-Librarian" 1901.

Dr. Garnett was a Member of the Society of Arts' Committees on The Deterioration of Paper and on Leather for Bookbinding. He presided on several occasions at the evening meetings, and in 1900 he was elected a Member of the Society.

GENERAL NOTES.

TRADE OF TEXAS.—The British shipping entered and cleared at Galveston, taking the average of the last five years, is about six-sevenths of the whole of the foreign shipping visiting the port, but in 1904, for the first time in recent years, German imports direct into Galveston exceeded those of Great Britain—£128,320 as against £92,874. "During my twelve years residence in Galveston," writes Mr. Consul Nugent in his report just issued (No. 3348 Annual Series), "I have hardly seen a British commercial traveller, and most of the trade applications received here are from firms wishing to be placed in communication with exporters." It is true that the tariff is almost prohibitive and that the country is comparatively sparsely settled, and with comparatively few factories requiring raw materials from abroad, but Mr. Nugent thinks Galveston should (and might) receive a larger portion of £30,000,000 British imports into the United States.

THE FINANCES OF SAXONY.—The complaint is often made that Consular reports are belated but this cannot be said of Mr. Sturdy's report on the finances of the kingdom of Saxony (No. 3542, Annual Series), which is not only up-to-date but is ahead of date, that is to say it covers the years 1906-7. The explanation is to be found in the fact that the Saxon Legislature meets only once in every two years, the estimates being drawn up for a similar period. The figures appearing in Mr. Sturdy's report accordingly, in every instance, represent exactly one-half of the total estimates of 1906 and 1907. It is noticeable that in Saxony, as elsewhere, local indebtedness grows apace. In 1870 it totalled £1,617,050, in 1900 it had increased to £16,638,331, and the increase in the decade 1890-1900 was far greater than in any preceding one. The average taxation of the country Mr. Sturdy puts at £1 17s. 6d. per head. The Legislature assembles towards the end of every alternate October, or the beginning of November, when the completed accounts for the last financial period but one, and the estimates for the forthcoming two years are at once laid before it. Each Chamber appoints two or more financial committees to whom the different votes are submitted for detailed examination. Should the consent of either Chamber be repeatedly refused by a majority of more then two-thirds, or should the Legislature be dissolved before its consent has been given, or the opportunity for its consent be lost through lapse of time, the existing duties and taxes have to be levied for one year following. Pressing financial measures, including the raising of loans, may be taken on the authority of the Crown should there not be time to summon an extraordinary session of the Diet, subject, however, to the consent of the next ordinary meeting of the Diet.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

APRIL 25.—"The Production and Collection of the Picture Postcard." By FREDERIC T. CORKETT (of the firm of Messrs. Raphael Tuck and Co.). CARMICHAEL THOMAS, Treasurer of the Society, will preside.

MAY 2.—"Submarine Signalling." By J. B. MILLET. SIR WILLIAM WHITE, K.C.B., F.R.S., will preside.

MAY 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By PROFESSOR THOMAS OLIVER, M.D., LL.D.

MAY 16.—"The Development of Watermarking in Hand-made and Machine-made Papers." By CLAYTON BEADLE. SIR FRANCIS HAYDN GREEN, BART., will preside.

MAY 23.—"A General Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E. SIR WILLIAM H. PREECE, K.C.B., F.R.S., in the chair.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

APRIL 26.—COLONEL SIR HENRY McMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, "Seistan: Past and Present." SIR WILLIAM LEE-WARNER, K.C.S.I., Vice-President of the Society, will preside.

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MAY 1.—"Social Conditions in Australia." By the HON. J. G. JENKINS, Agent-General for South Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock :—

May 8.—"Damascening and the Inlaying and Ornamenting of Metallic Surfaces." By Sherard Cowper-Coles.

May 29.—"Glass Cutting." By Harry Powell.

*** This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

Alfred Maskell, "Ivory in Commerce and the Arts." Three Lectures.

Lecture I.—April 23.—The structure and chemical composition of ivory—Its domestic utility and association with the arts—The elephant and the formation of its tusks—Varieties of the species—The Indian and African elephant—The mammoth and other prehistoric proboscideæ—Big game hunting in Africa and India—The sources and collection of ivory—Tusks and their qualities: their size and particulars of record lengths and weights—Hippo, walrus, narwhal, and other ivory-producing animals and cetaceæ—The ivory trade and chief centres of importation—Ivory sales and the "ivory floor" at the docks—Market and retail values—Applications: billiard balls, &c.—Remarks on statistics of imports and exports—The possible extinction of the African elephant—Big game preservation and the International Convention of 1901—A rapid review of the history of ivory in the arts and for domestic purposes from prehistoric times to the present day. (Many specimens and a large number of lantern slides will be shown.)

MEETINGS FOR THE ENSUING WEEK.

Monday, April 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. Maskell, "Ivory in Commerce and in the Arts." (Lecture I.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. W. Willis Bund, "The Effect of the Education Act, 1902, on Rural Districts."

British Architects, 9, Conduit-street, W., 8 p.m. Messrs. G. P. Bankart and Lawrence Turner, "Plasterwork."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Prof. Hull, Review of Sir Henry Howarth's Book, "Ice or Water."

Antiquaries, Burlington-house, W., 2 p.m. Annual Meeting.

Tuesday, April 24...Royal Institution, Albemarle-street, W., 5 p.m. Prof. G. Baldwin Brown, "Greek Classical Dress in Life and in Art." (Lecture I.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Annual General Meeting.

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Prof. S. J. Chapman and Mr. Douglas Knoop, "Dealings in Futures in the Cotton Market."

Anthropological, 3, Hanover-square, 8 p.m.

Wednesday, April 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. F. T. Corkett, "The Production and Collection of the Picture Post-card."

Civil Engineers, 25, Great George-street, S.W., 8 p.m.. (James Forrest Lecture.) Mr. R. A. Hadfield, "Unsolved Problems in Metallurgy."

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover-square, W. 4½ p.m. (Annual Meeting.)

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Thursday, April 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Colonel Sir Henry McMahon, "Seistan: Past and Present"

Royal, Burlington-house, W., 4½ p.m.

Tramways and Light Railways Association (at the House of the Society of Arts), John-street, Adelphi, W.C., 8 p.m. Mr. G. H. Sheffield, "All Steel Cars."

United Service Institution, Whitehall, S.W., 3 p.m. Colonel J. D. Legard, "Proposals for the Future Raising, Organisation, and Training of the Artillery Militia."

Royal Institution, Albemarle-street, W., 5 p.m. Dr. P. Chalmers Mitchell, "The Digestive Tract in Birds and Mammals." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. L. Andrews, "Long Flame Arc Lamps."

Friday, April 27...Sanitary Institute, Parkes' Museum, Margaret-street, W., 5 p.m. Dr. G. A. Heron, "The Consumptive at Home."

Royal Institution, Albemarle-street, W., 9 p.m. Prof. F. W. Gregory, "Ore Deposits and their Distribution in Depth."

Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Mr. Walter Cave, "Fenestration."

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Mr. Louis Greaven, "Petroleum Fuel in Locomotives on the Tehauntepec National Railroad of Mexico."

Aeronautical (at the House of the Society of Arts), John-street, Adelphi, W.C., 8 p.m. 1. Capt. Robert Falcon Scott, R.N., "The Use of the Balloon in the Antarctic Expedition." 2. Sir Hiram S. Maxim, "The Experiments of the Brothers Wright."

Saturday, April 28...Royal Institution, Albermarle-street, W., 3 p.m. Prof. C. Waldstein, "English Furniture in the Eighteenth Century." (Lecture I.)

The numbers of the *Journal* for December 20, 1901 (No. 2,561) and January 24, 1902 (No. 2,566) are out of print, and copies are required. The secretary will feel much indebted to any member of the Society who happens to possess spare copies of these *Journals*, and can supply them.

Journal of the Society of Arts.

No. 2,788. VOL. LIV.

FRIDAY, APRIL 27, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, APRIL 30, 8 p.m. (Cantor Lecture.) ALFRED MASKELL, F.S.A., "Ivory in Commerce and in the Arts." (Lecture II.)

TUESDAY, MAY 1, 4.30 p.m. (Colonial Section). HON. J. G. JENKINS, Agent-General for South Australia, "Social Conditions in Australia."

WEDNESDAY, MAY 2, 8 p.m. (Ordinary Meeting.) J. B. MILLET, "Submarine Signalling."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 23rd inst., Mr. ALFRED MASKELL delivered the first lecture of his course on "Ivory in Commerce and in the Arts."

The lectures will be published in the *Journal* during the autumn recess.

FRANKLIN COMMEMORATION.

A Special Meeting of the American Philosophical Society was held at Philadelphia on the 17th, 18th, 19th, and 20th inst. in commemoration of the 200th anniversary of the birth of Benjamin Franklin. The Society of Arts was represented at the meeting by the British Ambassador at Washington, Sir Henry Mortimer Durand, K.G.M.G., K.C.S.I., K.C.I.E., who has been a Member of the Society of Arts since 1897.

Some notes about the connection of Benjamin Franklin with the Society of Arts will be found on page 633.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

NINETEENTH ORDINARY MEETING.

Wednesday, April 25th, 1906; CARMICHAEL THOMAS, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Barr, Colonel Sir David William Keith, K.C.S.I., 40, Evelyn-gardens, S.W.

Bean, Alfred William, Singapore, Straits Settlements.

Cowan, Major Bryce William, D.S.O., Cowan's Post, Mafeking, South Africa.

Cowling, Charles Ernest, 7, Dolman-road, Aston-manor, Birmingham.

de, Rymkiewicz, Baron Bromislau, 51A, Conduit-street, W.

Dupernex, Hubert Emile, 34, Ventnor-villas, Hove, Sussex.

Foucar, James Louis, B.Sc., Beaulieu, St. John's-park, Blackheath, S.E.

Gallinagh, James P., Electricity Works, Limerick, Ireland.

Greig, Gordon E., Ipoh, Perak, Federated Malay States.

Hoeltzel, Dr. Max, Stafflenbergstrasse, 24, Stuttgart, Germany.

Iyer, T. Subramanya, Madras, India.

Jacques, Fred., Bangu, Ramel Sant Cruz, E.F.C.B., Rio de Janeiro, Brazil, South America.

Merson, Geo. O., Confederation Life Building, Toronto, Canada.

Mody, Ardeshir Maneckji, 107, Princess-street, Bombay, India.

Mudaliar, Rao Bahadur Bangalore Perumal Annaswami, K.I.H., 3A, Osborne-road, C. and M. Station, Bangalore, India.
Pantulu, Madapati Venkateswar Row, Nuzvid, Kistna District, Madras, India.
Parsons, John E, 52, William-street, New York, U.S.A.
Perrins, Charles Henry, Heilbron, Orange River Colony, South Africa.
Rowlatt, Frederick Terry, National Bank of Egypt, Cairo, Egypt.
Scott, Walter, The Powell Duffryn Steam Coal Company, Limited, Aberaman-offices, near Aberdare.
Treacher, Sir William Hood, K.C.M.G., Lawday-place, Farnham, Surrey.
Usher, Harry, Ferro Carril de Antofagasta á Bolivia, Antofagasta, Chili, South America.
Wyndham, The Hon. Hugh Archibald, P.O. Kromdraai Station, near Standerton, Transvaal, South Africa.

The following candidates were balloted for and duly elected members of the Society:—

Barclay, S. F., The Elms, Queen's-park, Manchester.
Forsyth-Martin, Alexander, Chief Surveyor, Royal Railway Department, Siam.
Marriott, Hugh Frederick, care of Messrs. Wernher, Beit and Co., 1, London-wall-buildings, E.C.
Maynard, Henry W., St. Aubyns, Grosvenor-hill, Wimbledon.
Mookerjee, R. N., Messrs. Martin and Co., 6 and 7, Clive-street, Calcutta, India.
Pal, J. N., I.C.S., Joint Magistrate, Sitapur, United Provinces, India.
Rand, William George, 82, Hurstbourne-road, Forest-hill, S.E., and The Niger Company, Ltd., Surrey-house, Victoria-embankment, W.C.
Sullen, Arthur E. B., Dunmurry-house, Simla, India.
Venkayya, Rai Bahadur Valaiyattur, Officiating Government Epigraphist, Ootacamund, India.

The paper read was—

THE PRODUCTION AND COLLECTION OF THE PICTORIAL POSTCARD.

By Frederic T. Corkett.
(Of the firm of Messrs. Raphael Tuck and Co.)

The subject-matter of this evening's paper may, perhaps, at first glance, appear to be of insufficient importance to deserve the attention of the members and friends of this distinguished Society. I hope, however, to be able to show that, at least, there is much of interest attached to this subject. My credentials are the fact that I have been personally connected with postcard production and distribution since the first year of their manufacture in this country—namely, 1894—and have since this date been continuously responsible for, perhaps, the greatest proportion of postcards that have emanated from the works of the largest British publishers of these interesting postal missives. Picture postcards are at present so very much in evidence, are on show in immense variety in the windows of our retail shopkeepers all over the kingdom, and are so much a part of modern life that, perhaps, no excuse need be offered in bringing this subject before the Society. Picture postcards enter very largely into the life of the public to-day, and, whether one looks at the extremely interesting nature of these little publications or their utilitarian object, there can be no doubt of the usefulness and advantage to be generally gained from their existence and use. That many do consider these little postal missives as among the inconsequential matters of life I am aware; but I claim that the picture postcard serves a very useful purpose, that it is in its best sense a highly educational medium, and, what is by no means unimportant, a time-saver. The industry of picture postcard-making employs, too, a very large number of hands, and provides also to our excellent postal system a very remunerative additional increment.

Of all our British institutions, perhaps, our postal system and methods are to be most admired; they are far and away ahead of all other nations, but if there is one institution that suffers from that hammered bugbear "red tape" more than another, it is surely our General Post Office. I particularly refer to some of the vexatious regulations relating to postal cards, pictorial and otherwise. On this matter, I have only time to refer to the existence of these regulations, and to say that it is the hope of all manufacturers that some of these regulations may be speedily removed or better adjusted to the requirements of the moment.

At the outset I will endeavour to show how and from what source the picture postcard came.

The origin of the first illustrated postal card is like many other origins—a matter of obscurity; but as it is a question of little real importance, I do not know that I need here dwell upon it. Suffice it to say that perhaps the first picture postcard produced was one printed by a French stationer for the use or in commemoration of a visit of a regiment to

the town in which the stationer resided, and this in 1870. Picture postcards have, therefore, been in existence on the Continent for thirty-five years.

The first picture postcard was, therefore, undoubtedly of Continental inspiration, and was of French origin; but while this was unquestionably so Germany is the true home and fatherland of the illustrated postcard. It quickly gained a great hold on the people of Germany and Austria, and for nearly twenty years has been popular, every year showing a marked increase in production and popularity. Italy quickly followed the example, and then in turn Switzerland, Holland, Sweden, Norway, Russia, Spain and Greece. We here in Great Britain were among the last to fall under the spell. Prior to 1894 (the first year of British postcard manufacture), a few postcards from Continental publishers were to be seen in the windows of art dealers and high-class stationery depôts, these of course being offered for the delectation of collectors, who were then beginning to come into existence. These cards were, however, only to be seen in one or two art dealers' windows in London. They were mainly of eccentric design, and appealed particularly to those with some knowledge of art and its varied phases.

It may cause some little surprise to most of those who are accustomed to-day to see picture postcards everywhere to hear the year of 1894 named as the first year of British postcard reproduction. The reason for this apparent neglect, however, was to be mainly attributed to the small-sized postcard permitted previous to 1899 by the postal authorities, upon whom some pressure had to be brought ere their consent to the larger Continental sized postcard could be obtained. While postcards were introduced to the British public about a year prior to 1894, it is really only during the last six years that the postcard pictorial has really come into strong favour with the public.

In 1894 a London firm of Continental origin was established solely for the publishing of pictorial postcards. In the same year an Edinburgh house commenced the issue of picture postcards; and these two houses, together with the British Photographic Publishing Company, of Leicester, were the only publishers of picture postcards in Great Britain, and were, therefore, the trade pioneers of the picture postcard in this country. These firms made a beginning, and being manager and part proprietor of the last-named concern, I can speak feelingly when I say that the introduction of postcards to the stationers and retailers of Great Britain was then very uphill work indeed.

Prior to this date it was not unusual for persons sending letters through the post to attach small circular or oval photographs to the back of their letters or cards. Some of these devices were embossed, and took the shape of wafers and tablets the better to secure the contents of the parcels, but it would not be fair to consider these devices in the category of picture postcards.

No picture postcards were produced in this country prior to 1894, this being the first year postal authorities allowed privately printed postcards to pass through the post. These first cards were all of the old Court-shape pattern—that is, $4\frac{1}{2}$ ins. by $3\frac{1}{2}$ ins. This size was the then official pattern fixed by the postal authorities, and not very great scope was afforded by this limited shape and area. These first picture cards, too, were by no means full-view ones, and the idea we early publishers worked to was to cover this small sized card with about one-third illustration, the remainder being space for correspondence. The first picture postcard, however, produced in this country was an official one, and was sold at the London Royal Naval Exhibition in 1891, the cards bearing an illustration of the Eddystone Lighthouse, a model of which was erected in the grounds of the Exhibition. The cards were intended to be written and handed to an assistant at the top of the model, who posted them for the sender, and thus a missive reached a distant friend from the top of the lighthouse itself. The card was printed in blue ink, and on the address side bore a device incorporating an anchor and crown. This commemorative card is, therefore, Great Britain's first picture postcard.

In 1899 the postal authorities authorised the larger card—namely, $5\frac{1}{2}$ ins. by $3\frac{1}{2}$ ins. This size at once gave greater scope; the shape, too, being of greater artistic possibility. No doubt the postal authorities were influenced by a desire to foster the pictorial postcard trade, as a very increased revenue was then being secured by the Continental postal departments, particularly those of Germany and France. The postal authorities, however, did not agree to the use of a larger size until an amount of correspondence had passed with them on the subject, and it is the managing director of Messrs. Raphael Tuck and Sons whom the public have to thank for the larger sized post-

card coming into existence perhaps sooner than otherwise it would have done, if early attention had not been brought to its necessity.

Perhaps amongst the early cards one remembers best the designs of "Mucha." Some of the early postcard designs of this gifted artist were very fine, but the cards the British public will remember as seeing most of in the first place were the view cards of British scenery printed in black on blue tinted board, giving moonlight effects. These cards were the specialty of a London house, and were printed in collotype, which, with effective heavy skies and moons, gave strikingly realistic night effects. Some of the early subjects, however, had peculiarities that gave away these moonlight effects somewhat, and showed that they were simply daylight photographs darkly printed, with the moons in some cases none too well adjusted. Be this as it may the general effects were good and were a credit to the publishers. Postcard taste has all along, like most other matters, had its epochs; the first British stage might, therefore, be called the "Moonlight - Sunlight Epoch." Passing from this stage we arrive at the "Collotype View" epoch, which gradually merged into the "Half-tone View" epoch. In these stages, which take us to and beyond 1899, the whole gamut of change was played on the simple view card, generally covering from one-third to two-thirds of the available space, the view being sometimes printed with a slight design of a floral or formal device, but generally the view and title only.

Up to 1899 very little had been published excepting local view scenery. A few topical cards, one or two comical series of a somewhat crude character, and a political skit or two were all that had been done. A card that all collectors will remember, perhaps, more than any other was one published by myself at Leicester, termed "The Little Englander." The postcard was simply printed in half-tone. It was a picture of that imaginary individual, "The Little Englander," marooned on his own little island, stripped of all except his unmentionables.

In the year 1899 the postcard trade in this country began to assume larger proportions, and to attract the attention of the larger art publishing firms. Several important firms took up the postcard trade in 1899, and their persistent advertising methods and postcard competitions undoubtedly gave a great fillip to the postcard trade, many stationers and art dealers who had previously held aloof now taking up the matter in a more serious manner. In July, 1900, a monthly magazine, entitled "The Picture Postcard," appeared. This magazine is still in existence, is well written and well informed, and is of interest to all connected with the subject-matter of this paper.

Having now given a short history of the rise of the postcard in this country, it might be as well here, perhaps, to consider the reason of the popularity of the pictorial postcard. The editor of the "Process Photogram," in a recent number wrote :—"The postcard vogue on the Continent comes from the sociability of the people. Quite half of the company who sit and sip their lager beer in the German gardens or 'Tonhalle,' have a packet of postcards at their side, and the despatch of mementos of the occasion is a regular part of the proceedings when friends meet." Now, with all deference to the writer, I think the great utility of the picture postcard is that it enables one to do something friendly, gracefully, quickly, and with a minimum of trouble. You arrive at Paris, Venice or elsewhere. One packet of postcards, five minutes or less, and your correspondence is done, and a dozen friends made happy by the receipt of a picture postcard from the distant tourist. All so easy, too. Just "Love from Jack," or "Fine place this," and the picture does the rest. The picture postcard is simply a continuance of the "you touch the button and we do the rest" idea. It is part and parcel of the busy, rushing, time-saving age we live in. It comes so useful, it answers the purpose, it is a time-saver, and is the quick means of paying a graceful and appreciated compliment to the friend at home. What can be more interesting than to receive friendly missives on pictorial postcards, showing at the same time the surroundings of the distant writer?

The conclusion we, therefore, come to as to the *raison d'être* of the post card is that it fills a real want, and is certainly a very welcome one in the busy age we live in. As to the permanency of the pictorial postcard's existence, we hear a great deal from pessimistic individuals, every now and then, that the craze will not last much longer, and that like the valentine the postcard will cease to exist. There is, in my estimation, no reason to think anything of the sort, always provided those responsible for the publication and sale of the picture postcard keep before the public good and artistic designs that do not trans-

gress the laws of decency and good taste, then so long will the postcard flourish; but if vulgar, comic rubbish is foisted on the public, and placed in conspicuous positions in the shops of postcard retailers, then as assuredly will the pictorial postcard fall out of favour with the public at large, and the collector and user of such cards fall under the ban of all right-thinking individuals.

Fostered by publishers of repute, the postcard trade of the present day has grown enormously, and it is very pleasing to note in this connection that the legend "Printed in Germany" is no longer so much in evidence as heretofore. Probably a great proportion of the material on which the cards are printed is still of Continental origin, but the British printers are and have been thoroughly wide awake to the possibilities of the trade, and as good work (to say the least) is now being done here in this country as ever came out of Munich, Berlin, or elsewhere in the "Vaterland."

I am of opinion that this craze has by no means assumed its largest dimensions, but of course it would be unreasonable to expect the trade in postcards to increase in the same ratio as it has done since only 1899.

Mr. G. R. Sims, in his inimitable *Referee* notes, lately commented on the postcard trade as observed by him on a Continental tour. He said :—

"The picture postcard is an enormous industry on the Continent. Wherever you go picture postcards stare you in the face. They are sold at cigar shops, libraries, chemists, and fruit stalls; they are arranged on stalls and every table at the restaurants; they are in the halls of hotels; they are at railway stations; they are hawked at the landing-stages of the steamers; the driver of the diligence keeps a few in his hat; and I have not the slightest doubt that in every place frequented by tourists if you were to ask your way of a policeman he would tell you and then produce a little stock of picture postcards for your inspection."

I can attest Mr. Sims's remarks. On my holiday last year I was really astounded at the length to which the "craze" had gone At every station, from Paris to Venice, postcards were on view, and wherever opportunity offered hawkers came along the carriages offering excellent cards, showing, of course, the local views. At the first station after passing the Mont Cenis Tunnel in the early morning, two earnest-eyed lads were waiting for the train, each laden with postcards for our examination. At the hotel in Venice the first person we saw was addressing postcards as for dear life, and the intimation that the hall porter had a fine selection of postcards was still ringing in our ears while we gazed at that marvellously enchanting sight, St. Mark's a few yards away.

Illustrated postcards have, to a great extent, taken the place of the photographic print trade, for, whereas tourists were accustomed at one time to buy a dozen or two silverprints of each district visited, now the penny postcard takes the place of the view and answers the same purpose, and at a much less cost. Here, therefore, is perhaps the greatest reason for the popularity of the view postcard, and as this section of the postcard trade is its backbone and mainstay, I see reason to think it will always remain so. Valentines have come and gone, Christmas cards are still with us and likely to be, but the popularity of the picture postcard will outlast either.

Speaking of the development of postcards in this country, it might be interesting to note that, from a Return issued by the Postal Union for the year 1903, the inhabitants of Great Britain posted no less than 613,000,000 postcards, while in Germany no fewer than 1,161,000,000 were posted during the same period. In the United States, too, whose population is about half in excess of that of Germany, 770,500,000 postcards went through the post; Japan was previously next to Germany, but is now fourth on the list with a total of 487,500,000. It must be remembered that a great nnmber of these postcards are not picture postcards, being those of official origin and ordinary business communication cards. A postal authority, however, computes the picture postcards posted in 1903 in Great Britain as about three-quarters of the full total, so that gives 450,000,000 picture postcards for 1903. Some of the postal authorities at our great holiday resorts last year took a census of the picture postcards passing through their hands, and at Blackpool this last year (1905), during the holiday season (June to August), reported a weekly average of 215,000 picture postcards as having been sent from the town, and that during the first week in August the total reached 300,000 for the week—a truly marvellous quantity.

These view postcards would, therefore, serve a double purpose, and would advertise the attractions of the town in a most effective manner. In this connection some of our largest corporations have taken up the picture postcard. The London and North-Western

Railway Company, for instance, have a capital series of illustrated postcards of places of interest on their system, which series also include illustrations of locomotives past and present, rolling stock, bridges, stations, and quaint illustrations showing how we travelled in the "fifties," compared with the luxuries and comforts of to-day. The good old times we occasionally hear so much about were evidently, from these illustrations, very uncomfortable old times, to say the least about it.

More than two-thirds of the postcards that are published in Great Britain are view postcards, and the view of photographic origin, that is to say, the printing plate is made either from a plain silver-print photograph or a tinted or coloured print. In the first instance, much variety and diversity of effect has been and is still being shown. The views are printed in collotype or from half-tone blocks in one or two workings, and are sold generally at a penny per card, or in cases of photogravure or silver bromide at 2d. per card. In connection with postcard production I can only say it is my experience the best print and best plate are none too good for the public. For the finest result is always more attractive and more appreciated by the public than something that on the face of it looks cheaper.

In all work connected with postcard production it is my experience there is more room on the top than at the bottom, more room for the best work than the cheapest.

In collotype one sees very little of really good work in postcards; it is a process, to my way of thinking, that does not flourish in this moist climate of ours. There are houses here in this country that can and do turn out fine work, but the work on the whole suffers when compared with the average work of Continental houses. Collotype is by no means a difficult process to work, but my experience is that our friends in Germany can do high-class collotype certainly cheaper than we can.

Now, with respect to the production of silver bromide postcards, or what are now generally known as real photographic postcards, these cards being of course real photographs, inasmuch as each card is exposed to light direct from the negative, and then developed in continuous bands on special machinery. One firm alone estimates their weekly output as 1,000,000 cards or 20,000 yards of sensitised material 34 ins. wide. These postcards, too, are mainly of theatrical celebrities. There is no reason to wonder at the popularity of the 2d. bromide postcards; their value in the mind of the public is that they are so much clearer and illustrate the subject so much better than either collotype or half-tone can do. It is not because they are direct photographs or that they are printed from sensitised material, but that their general appearance is superior, and hence there is no difficulty in getting the higher price, another proof as I previously stated of there being more room for the better card than the cheaper one. Perhaps some of our celebrities have no reason to be grateful to the publisher of picture postcards, for the postcard collector is most enthusiastic in getting his postcards autographed by the personage depicted on the cards. Some of our well-known actresses have received as many as fifty postcards a day for the purpose; in fact, so much has this become a feature that most celebrities demand, and rightly, too, a fee which they devote to charitable purposes for this wholesale autographing.

Of all the monochrome processes of reproduction it may be said that the very first essential is to have a first-rate original or print to work from in the first place and for each method a special original of a particular nature is desired. In simple monochrome I am sure by this time almost every scene of general or historical interest has been done, and it will be extremely difficult for the postcard publishers of the future to turn over fresh ground in this direction. The abbeys, castles, cathedrals, rivers, mountains, and lakes of the country have all been minutely illustrated and recorded on the postcards of the many publishers of these goods. I do not say that fresh ground is not possible, but I do say that no little ingenuity will be required to present the old familiar views with new features and by new methods. In the realm of monochrome, perhaps the most distinctive cards that will have been most familiar to the general public after the miscellaneous general collotype view postcards seen everywhere, were the large series (some 500 designs) of rough-sea postcards. These cards were very attractive and depicted the sea in its stormiest and most interesting mood. The cards were all produced in collotype, and were at that time the most successful and attractive series issued by any publisher of picture postcards in this country. They took the public "by storm," so so speak, and rough-sea postcards were on show in every stationer's window. It was simply a case of presenting a beautiful phase of nature

before the public and of public appreciation of an attractive article.

Continuing therefore in our postcard epochs, the years of 1902 and 1903 might be termed "The Rough Sea Epoch." Overlapping this period we have the coloured view postcards, these then becoming decidedly a strong feature. Postcards in colour of British scenery were in many publishers' lists, but did not assume any great prominence here until about the summer of 1901. The following summer, however, saw almost every stationer, especially in our tourist resorts, showing the local-view postcard printed in colours. Now, these cards were mainly, in fact, almost exclusively, of Continental origin, and bore that familiar legend "Printed in Germany." This legend, by the way, has been a perfect godsend to Germany, of course, in effect, advertising the wares of our rivals, and there are hundreds of Continental manufacturers even at the present time who firmly believe that the reason for this legislative Act was the necessity of bringing before the public the evidence of the excellent cheap goods the German makers were able to produce. I say that, in printed goods at any rate, this Act that demanded the aforesaid legend has been of the greatest service to Germany, and has had exactly the opposite effect to that legislation intended.

In the question of colour postcard production Germany still perhaps heads the field, that is to say, when the whole world's consumption is taken into consideration; but it is extremely gratifying to say that, so far as the British Isles are concerned, view postcards of Continental production no longer predominate. In this particular direction cards of our own manufacture hold the field and are likely to do so. Further, the tide has turned, and several printing houses are sending postcards into our rivals' own country. This, perhaps, is mainly due to the superior excellence of our original work. I do not think there is any European country that has so many competent postcard artists and designers as we have here in England, and it is owing to our superiority in this respect, as well as to the first-class production of the printer and engraver, that we are enabled to do more than hold our own.

To a great extent my remarks up to the present have been confined or nearly so to the varying aspect of the view postcards. Up to the present time the great bulk of the postcard trade has been done with view cards, portraying the scenic beauties of the land we live in. We have seen the view postcard in all its different aspects under this section. The coast has been tapped and shown in all its rugged picturesqueness, our quiet lakes, our winding rivers, our castles, abbeys, and cathedrals have had all their special beauties displayed. Perhaps my remarks have helped to convey the impression that as so much has been done there is now really little more to do. As a matter of fact, I see the postcard horizon and its possibilities ever extending, and it is here the skilful publisher comes in, suggests new ideas and formulates new possibilities. The public will ever buy the view presented under some different aspect, and Nature's moods are many and varying.

Instancing the very miscellaneous nature of the illustrations used on postcards, from a file of cards before me, I find such differently treated subjects as "Greetings from South India," a representation of a party duck-shooting, with distant Buddhist temples in the background; a view of tobacco plantations of Havana, with the natives busily gathering the plants; a card of "Count Zeppelin's Airship," evidently intended to memorialise the event of its first flight; a view of a German warship, with the Kaiser's bust embossed in gold, the use of this card is evidently to arouse interest in the German navy; a comic seaside bathing incident—a youth in the water, while a dog ferociously tears his clothes to pieces; while another card, and an exceptionally well-executed one, represents a bearded Boer on horseback carrying off from the field a wounded comrade. On the Continent, every phase of life and art has been displayed upon the picture postcard. The pretty surf bathers, the Alpine tourist toiling upwards to the conquest of a new peak, the sunny Italian vineyards, the gondolas of Venice and the charming fjords of Norway, and the masterpieces of the world's galleries have all been eagerly sought for and have their special admirers and collectors. When it is seen that the almost universal price at which these cards are issued is but 1d., or its equivalent, it will not be wondered at that such a charming and inexpensive hobby has found so many enthusiastic collectors and admirers. Compared with stamp collecting and coins, the collecting of postcards is a no less engrossing hobby, for the individual cards, apart from their pleasure-giving properties, must in many cases become scarce and valuable. While it is granted that the gambling element (if such an expression in connection with stamp collecting may be used) is absent in the matter of postcards, yet

enhanced prices for rare postcards are not infrequently obtained, and as much as one hundred times the published price has been paid for rare cards.

One would like to enumerate the many beautiful series of view postcards that have been published in this country up to the present time, but time does not allow of this. By far the most attractive, however, are those produced direct from good origiual oil paintings and water-colours by the tri-chromatic half-tone printing methods. Three-colour blocks, made here in England by several of our well-known engraving firms, are unbeaten by any produced outside this country. Some of our engravers use a fourth printing, which, if most carefully done and adjusted, pulls the subject together and greatly benefits it; but I have found a great tendency to overdo this fourth printing, for, if done at all, it requires careful adjustment.

It might be here advisable to give a little explanation of this tri-colour printing and plate-making methods, the principles of which are really very simple, although the practice is by no means so. Tri-colour printing is therefore founded on the three primary colours, yellow, red and blue, which being the base of all colours, should give, if rightly blended, a representation of any colour, provided the plates are correctly made and graded. The tri-colour printing plate-makers therefore, in the first place, proceed to make three photographic negatives, the yellow negative being photographed through a violet glass, termed a light filter, the red negative through a green glass, while the blue negative is secured through a red glass or filter. From these three negatives are made the three printing plates, and from these plates the edition is printed. The yellow impression is printed first, then the red impression on top of the yellow, and finally the blue on top of the first two. Both the British engravers and plate-makers and the British printers are ahead of any other nation in these particular methods.

It is a mistaken notion to assume that any class of original will do for three-colour reproduction, and it is just here that nothing but long experience comes in to assist the publisher. After an experience of five and half years, handling something like nine or ten thousand originals expressly produced and painted for reproduction by tri-chromatic printing method, I can affirm that a great deal of technical knowledge is required to adjust original work or this process—that is to say, to adjust it in such a way as to ensure the finest results. Cards produced by the three-colour half-tone process are at the present moment the greatest feature perhaps of the postcard trade, and, combined with the always popular series of monochrome postcards of actresses and celebrities, form the bulk of the stock of the up-to-date postcard retailer, and are the cards that attract the general public. Bringing our epochs therefore up-to-date, we might term the present "The Tri-colour View and Bromide Actress Epoch."

It might, perhaps, be well now to take in review the notable series of postcards other than view postcards that have been published since their introduction into this country. The late war in South Africa gave a great impetus to the postcard trade in this country. In the first place it furnished a vast wealth of material, and our "Tommies" found the postcard a quick and handy means of conveying thoughts and wishes to the "old folks at home." Some of our finest artists, too, lent themselves to the idea, and the series of Black and White postcards, from originals by Caton Woodville, did credit to the publishers of that time. These cards had a very large sale, both in Great Britain and abroad. Our friends the Germans had their series of Boer War postcards too, but the subjects were differently treated, as you may suppose. One of the favourite and best-selling series in Germany I remember depicted our soldiers firing on the Boer field hospitals. Of course, we were shooting down all, young and old, male and female, while a heroic Boer rushed out and had simply paralysed one of our men, who was holding up his hands in piteous appeals for mercy. Our friends in the "Vaterland," too, ridiculed our "Concentration" camps, a method which in their present dealing with the Herreros they have themselves been compelled to adopt. Portrait postcards of Lord Roberts, too, were very prevalent during the Boer War, and one I have depicting our most able General was sent me direct from a friend at Paardeburg. It was despatched on the eve of that great battle by a soldier in the action. He had written on it "He's a good un heart and hand." When the City Imperial Volunteers left London for the seat of war a special postcard was issued to celebrate the occasion, and on their successful return another was similarly published. Postcards also celebrating the defences of Ladysmith and Mafeking were published. So quickly do passing events fade into the past that now these postcards

seem quite ancient history. Of course our late Queen Victoria had many postcards portraying her loved features, and at her lamented death postcards of Her Majesty and of incidents connected with her glorious reign were displayed in every stationer's window. Of our present King and Queen, of our Prince and Princess of Wales, the young Princes and Princesses, there are almost innumerable cards obtainable. The very latest card in this respect is one just published, being a souvenir of the visit of the Prince and Princess of Wales to India. The coronation of His Majesty King Edward presented another splendid opportunity for postcard enterprise, and here again the designs were legion. The pageant itself was depicted in all its glory and reproduced in both colours and monochrome. The decorated streets, the coronation chair, the regalia and jewels all were displayed on postcards and in most cases remarkably well done too.

The visit of a monarch to this country has also been treated as a great event in our history. When the Emperor William came over to attend the funeral of our late Queen, picture postcards of the Kaiser were well to the front, and the same may be said of the more recent visit of the Kings of Italy and Spain.

To art collectors, perhaps, the postcards showing the treasures of our public Art Galleries would be most appreciated. All the more prominent pictures of most of our public collections can be secured for the humble penny, while the contents of our museums and public buildings have not been overlooked. Postcards of the statuary of our London streets (badly wanting cleaning, by the way) are also readily obtainable.

An attempt was made two years ago to revive the valentine trade by the introduction of valentine postcards, but this was not so successful as anticipated. The advent of the postcard as a Christmas card, however, is a great success, and hundreds of designs for Christmas postcards are being produced, and they will, doubtless, form an attractive feature of our stationers' windows on the near approach of the next festive season.

Of important general subjects that from time to time have been produced on postcards one should, perhaps, name the collection of cartoons from *Punch*. In the first place, a large selection was made by a London publisher, and produced by a monochrome process. The collection of jokes from *Punch*, now being published by Tuck's, and produced in the highest style of colour-printing, are being much sought after by collectors and are eminently successful.

Some time ago a well-known artist, Mr. Frank Emanuel, stated that British publishers were overlooking the large amount of excellent art that was being applied to picture postcards on the Continent. In an article in the "Magazine of Art" Mr. Emanuel proceeded to trounce the British postcard publisher unmercifully, and in the main he was right. But the remarkable strides in art publication on postcards made since this article was written (just two years ago) warrant me in saying that certainly as fine sets of artistic postcards have emanated from certain of the postcard publishers of Great Britain as has ever come from the finest printing and publishing Continental houses. In view and landscape postcards no finer subjects, nor better adapted for postcard reproduction, have ever been reproduced than the works of Charles Flower (old London churches, Inns of Court, our cathedrals, &c.), Ricord Cordingley (marine views), H. B. Wimbush (English scenic beauties), Longstaffe (Killarney, and Scotch mountain scenery and landscape generally), Elmer Keene (coast scenery), while the quaint corners of our isles have now found their exponent in Mr. Emanuel himself. I do not for one moment claim that the postcards of British production and design portray the variety of style or reproduction to any similar extent that the postcards of Germany do, but I do claim that first-class postcards of great merit and undoubted art are being produced and designed here equal to any productions of any country in the world.

Germany was the first to have offered the postcard field to the genuine artist, and she has had a large start ahead of this country, but let her look to her laurels; the British publisher, artist, and printer are coming along "hand over fist." I can speak of one firm, at any rate, which is sending postcards into Germany, no less than half a million British-made postcards of one particular series having been ordered by a Continental publisher for consumption in Germany and Austria. Much of the postcard work of the Continent may perhaps be best described as "brilliantly coloured and quaintly decorative," and, as a rule, much of these coloured Continental view postcards produced from original water-colours and oils are, while admittedly attractive, yet utterly imaginative and unlike the places depicted. Now

the British postcard buyer demands that his view postcard shall at least be like the place. Give him St. Paul's, say for instance from the river, or from anywhere else, in fog or in sunshine, or in any other phase of nature, yet it must be like St. Paul's, and there be no possibility of mistaking it for the Kremlin or the Pantheon. There are, I am sorry to say, a vast number of artists who, when they see some sort of eccentricity offered up as "art," cannot resist the temptation to fall down and worship it. Needless to say, in the realms of art there are numbers of eccentric designers who offer their wares as the perfection of all that is desirable and obtainable in "art." The artists of this vast school, I am pleased to say, find greater appreciation of their "crank" productions on the Continent than they do here. There need be now, at any rate, no lament on the part of the real artist that the public cannot appreciate what is good, either on postcards or in any other art production whatever. The public buy and appreciate a really clever card, but however clever it may be, it is of little real value if it fails in its likeness to the place depicted.

Nothing more beautiful than the postcards made from the oil and water-colour paintings of Ricord Cordingley have ever been reproduced on postcards, or even otherwise. This artist I, am aware, is not an Englishman, but his work was first reproduced on postcards in this country. His treatment of night scenes and quaint harbours lit up by the lamps of the fishing fleet, are wonderfully realistic, li tle pictures that stay ever in one's memory, and his beautiful cards are enough to start the most prosaic individual postcard collecting. That such truly delightful cards can be purchased for 6d. a packet of six (and such wonders of reproduction too) is one of the signs of the truly cheap times we live in. Equally fine, too, are the views of Norway by T. W. Eckenbrechner, also published in London. These cards are printed in so-called four-colour, which, however, is the usual triphotochromatic method, with a fourth tint added, and so delicately and appropriately done is this additional strengthening printing in this series, that the finished result is very near perfection.

Tri-photochromatic printing and plate-making has reached in this country a high state of excellence, yet in postcard work the possible results are none too often seen. One sees so much work in which there is an utter lack of fine etching, but perhaps when one knows the really low prices that are paid for so many of these postcard plates it is not to be wondered at. Where also a too often unsuitable original is handed to the engravers, what else but utter failure can be expected? There is a prevalent idea abroad, and this among artists and publishers too, who ought to know better, that any sort of original will do for reproduction for three-colour printing. A more truly belated notion never entered the head of a human being.

A clearly painted, bright and sparkling original is certainly what is required, and of all originals the work of that class of water-colourists who never seem to know what they are aiming at, but who eventually after much time and laboured effect finish up with wash-upon-wash effects, is to be most avoided. In such cases the camera sees and finds the underlying washes, and thus the getting of anything like facsimile results is to a great extent impossible.

In the direction of three-colour printing I think there is still likely to be some great improvement, and particularly so in the direction of three-colour lithographic printing, from aluminium plates. Lithographic colour-printing has been very much overshadowed of late by three-colour block printing, but in this direction, that is in photo-lithographic methods, there are surprises and improvements ahead.

With respect to the printing of three-colour postcard blocks, it is gratifying to be able to record that as good machines are being built in this country for this purpose as ever left the land of the Stars and Stripes, and further that more English-made machines for three-colour printing are being put down to-day than ever. These machines too are as cheap, as well made in every way, and as well adapted for the purpose in view.

Our American cousins have carried postcards across the Herring Pond, and picture postcards are daily in the States becoming more a feature of American life. Even the miners in the far Klondyke and Rocky Mountains send home to their friends in England postcards portraying their surroundings. I am at present preparing a series of South Sea postcards, and no doubt the traders there will shortly find that the best "trade goods" are picture postcards. May these always be of British manufacture is all I ask.

Every island of the West Indies, and even the best-known islands of the South Seas, have now their beauties displayed on picture post-

cards; go where you will—be it up the Nile or the St. Lawrence, across Spain, Hindustan, or Southern Italy—there you will find the postcard pictorial awaiting your selection.

During 1904 over 2,500 million postcards went through the post in Germany, Great Britain, and America alone. The figures for 1905 are not available, but it is expected for these three countries that nearly 5,000 million postcards will be about the figure for last year. The production and distribution of this truly vast quantity of picture postcards keeps an army of skilled and unskilled workers in constant employment in many countries. The picture postcard, too, has been a veritable boon to our own postal department, bringing in as it does a great and profitable business. Nor must the educational side of the picture postcard be overlooked. The age we live in might most aptly be termed "the pictorial age," for it is by means of illustrations in all methods and in all shapes and forms that truths are brought home to those who are not easily reached by other more orthodox methods. In this connection, therefore, the picture postcard has its purpose. What could be more educational, for instance, than the series of postcards of "British Battles," or of that fine series of "Colonial Incidents," being scenes connected with the acquisition of our Colonial possessions, both series just recently published by a London house.

Good postcards, too, are always great art educators, and the collection of these charming mementos cannot but tend to elevate and improve the mind.

In conclusion, I would say to the postcard collector:—"Collect only good, artistic, and interesting cards, cards which are always a pleasure to include in your album, or to send to your friends. Shun all indecent and undesirable subjects. Then will your collection always be a pleasure to your friends and acquaintances, and a delight to all who see it." To anyone who has anything to do with postcard distribution or production, I again say, "Do the best possible, there is always more room for the best than for the cheap and inferior, and always more room at the top than the bottom." To all I say, "encourage the collection of pictorial postcards, it creates a taste for knowledge, it is inexpensive, highly educative, and the inspection of a good collection of pleasing and artistic postcards can always be relied on to pass many an hour with pleasure and profit to all parties concerned."

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that the author had devoted twelve years of his life to the subject of the paper, and that the audience could not have listened to a greater authority on picture postcards. It seemed to him that the most satisfactory feature of the paper was the fact that such marked progress was being made in this country with picture postcards. When it was remembered that no fewer than 613,000,000 were posted in one year in this country, and 1,161,000,000 in Germany, it was possible to realise the vast future there was before printers of such an outcome of modern life. He could not help thinking that the people of England, as a nation of shopkeepers, as soon as they found there was money to be made in the production of picture postcards would put their backs into the work just in the same way as they had done with motor cars. It was only necessary so look at the daily papers to see what an important part postcards played in the daily life of the people. For instance, it had been stated in the papers during the past week that Princess Ena was to have a magnificent collection of pictorial postcards presented to her as one of her wedding presents, and in to-day's paper he had noticed that Miss Marie Corelli was giving work to the lawyers in connection with the pictorial postcards of her house at Stratford-on-Avon; while if one took a stroll in the park it was easy to recognise the effect of the Gibson postcards upon the work and action of the young ladies to be seen there. The excellent reproductions, not only of the old masters in the public galleries, but also those in the private galleries, must be, he thought, of real educational value, and for their very small scale gave a wonderful idea of the beauties of the paintings. If a serious collector every now and then weeded out all his rubbish, and retained only the best, such an album would be looked at, not only by a brother collector, but by every member of the community, with the greatest pleasure, while the collection itself would, in the course of time, become exceedingly valuable Mr. Corkett had been very modest in referring to the productions of his own firm, but he (the Chairman) had ascertained from him that Messrs. Tuck had produced 30,000 different designs of cards; and it was a pleasure to him to acknowledge that many of the finest specimens of printing on postcards that he had seen, had been produced by the firm with which Mr. Corkett was connected.

Mr. JOSEPH PENNELL said he had learned from the paper that the enormous success of the picture postcard was simply due to the fact that people were too lazy to use their brains and write letters, but he could not agree with the reader of the paper as to the artistic value of the cards of which specimens had been shown. Only one design exhibited, which was made in Germany, was of any artistic merit or specially designed for a

postcard; the others were bad water-colour drawings and pencil sketches produced at haphazard. It had been said by Mr. Corkett that the finest work in connection with postcards was now being done in England. Personally, he had only seen one set of decent postcards in which the design was made for the postcard, and they were sold in Venice long before England thought of doing such things, and he presumed they were a failure. No doubt the author knew a great deal about the production of picture postcards, but if he was not an artist himself, he (Mr. Pennell) did not think he should have given such positive opinions as to what artists should do. There was no doubt that artists could produce designs for postcards which were works of art, and which might be produced in an artistic manner, but, with the exception of a very few cases, such work had not yet been done, although, as the publishing of picture postcards seemed to be commercially successful, something might eventually be done in that direction. The result of the reproduction of the old masters by the three-colour process was absolute rubbish; in fact, all artists agreed that three-colour work had always been rubbish and always would be. Some other method might produce a proper result, but it had not been discovered yet. The collection of picture postcards was simply a fad, like the collection of postage stamps. Some collectors paid hundreds of pounds for a ridiculous inartistic thing, simply because there were only a few copies in existence, and thereby a fictitious commercial value was obtained for the article. If postcards were artistic and the work of artists, he could understand people collecting them, but they were not; they were simply the work of commercial firms. When good, artistic postcards were made he should be glad to see them; but if, as Mr. Corkett said, the best work was at present being produced in England, then so much the worse for England.

Mr. RICHARDS (editor of "The Picture Postcard") said that until he heard Mr. Pennell's remarks he had laboured under the delusion that a penny picture postcard might have a good effect in educating up the masses of the people to appreciate the work of artists, and he hoped that would result in the future. He quite agreed that a collector in collecting any article might put a fictitious value upon it; but there were tens of thousands of people who admired the works of old masters who could not afford to pay the huge sums at which they changed hands in order to place one in their own house. But by means of a good reproduction of the picture on a penny postcard the people of the country could have a copy of a great work of art placed in their own houses, and if the poorer classes of the community, especially those who could not afford to buy wood or steel engravings, would, instead of spending their money in buying beer and other luxuries put a few pence each week with which to buy postcards, they might decorate their homes with high-class reproductions of old masters, which would have a good effect upon their art education. To him, the paper had been exceedingly instructive and very encouraging as a member of the British public, who wished his fellow countrymen, whether artists or printers, or workmen, success in business life. Picture postcards gave a great deal of work, even to artists. Many artists owed their initial popularity to the humble and despised picture postcard; and there were artists at the top of the tree who did not now despise to have their choicest works reproduced by such meaus.

Mr. F. EMANUEL said that, as was stated in the interesting paper, a couple of years ago he wrote an article on postcards in the "Magazine of Art," in which he tried to slate somewhat severely English publishers, and complained that England was being left entirely out of the artistic struggle in postcard competition. Although the English publishers had made up a good deal of lost ground, it was ridiculous, in his opinion, to state that anything which had been produced in England came up to the best work produced on the Continent. It was a very curious fact that, so far, he had never seen an artistic card made in America. He agreed with Mr. Pennell that, if one judged picture postcards from the examples shown on the screen, the whole thing was unsatisfactory, because, in his opinion, the examples shown were neither good nor well reprodnced, with one or two exceptions, particularly the set of Mr. Cordingley's illustrating marine subjects, which, in his opinion, were amongst the best cards which had been produced. It was necessary, however, not to forget that some of the cards relied chiefly on their colour for their effect.

Count OSTROROG said that although, from an artistic point of view, the picture postcard could not compete with an etching, he thought the criticism on the postcards which had been exhibited was unduly severe. The views shown were, for the most part, simply illustrative of places of interest in the country, and were generally reproduced from photographs. In giving a practical history of the development of the picture postcard, Mr. Corkett had been obliged to refer to the various stages through which the postcard had passed from its initiation, and that was the reason why all the designs shown were perhaps not artistic. Certain allowances must also be made for the imperfection of the lantern slides; and as a previous speaker had remarked, some of the pictures had lost their effect from the fact of their being from colour work reproduced in monochrome, which was seldom satisfactory.

The CHAIRMAN desired to bear out the last remark made by Count Ostrorog. Having read papers at the Society, he knew with what surprise the author

sometimes viewed the illustrations thrown on the screen when they had been enlarged from a small sketch. Some of the subjects which he thought would show well on the screen did not do so, and *vice versa*. It afforded him very great pleasure to propose a hearty vote of thanks to Mr. Corkett for his interesting paper.

The resolution of thanks having been carried,

Mr. CORKETT, in reply, said he desired to apologise for the quality of the slides which had been shown, which were not intended, however, to illustrate the art possibilities of the postcards, but simply to illustrate points in the paper. As a matter of fact, more than one-half of the pictures he had shown were not made from postcards at all, but were specially produced to illustrate the paper. He did not know whether he was right in taking Mr. Pennell's rather severe criticism as a sort of counter-blast to the remarks he (Mr. Corkett) had made with regard to the wash-upon-wash effects of artists, which gave the printer an immense amount of trouble in trying to produce a facsimile result. He thought Mr. Pennell could not have used his faculties of observation when he said that there was no postcards produced by British publishers showing high art; at any rate, he could not have seen Raphael Tuck's cards. His firm paid large sums to artists of repute, and worked to their original designs; and in the opinion of many most competent judges, produced cards which were extremely artistic. Raphael Tuck's had produced about sixty of Mr. Cordingley's subjects, and the artistic world said they were excellent. The attack which had been made upon the three-colour process was an antiquated artist's idea. Some people said that an artistic card could not be produced by the three-colour process, but when a fourth strengthening printing was made the publishers went very near to obtaining an absolutely facsimile copy of the artist's design.

FRANKLIN COMMEMORATION.

In connection with the public commemoration in Philadelphia of the 200th anniversary of Benjamin Franklin's birth in 1706, it may be interesting to note some particulars of Franklin's relations with the Society of Arts. In 1755, the second year of the Society's existence, Franklin was elected a corresponding member, and in the "List of Members" published in 1756 he is described as "Benjamin Franklin, Esq., Philadelphia, F.R.S." This election appears to have given the great man much pleasure, and he sent the following letter in acknowledgement of the honour:—

[COPY.]

Philada Nov. 27, 1755.

I have just received your very obliging Favour of the 13th September last; and as this Ship sails immediately have little more time than to thank you cordially for communicating to me the Papers relating to your most laudable undertaking, and to assure you that I should esteem the being admitted into such a Society as a corresponding Member a very great Honour, which I should be glad I could in the least deserve, by promoting in any Degree so useful an Institution. But tho' you do not require your Correspondents to bear any Part of your Expence, you will I hope permit me to throw my Mite into your Fund, and accept of 20 guineas I purpose to send you shortly to be apply'd in Premiums for some Improvement in Britain, as a grateful, tho' small, Return for your most kind and generous Intentions of Encouraging Improvements in America. I flatter myself from that part of your Plan, that those jealousies of her Colonies, which were formerly entertained by the Mother Country, begin to subside. I once wrote a little Paper tending to show that such Jealousies with Regard to Manufactures were ill-founded. It was lately printed in Boston at the End of a Pamphlet which I take the liberty to send you. Never be discouraged by any Apprehension that Arts are come to such Perfection in England as to be incapable of farther Improvement. As yet. the quantity of Human Knowledge bears no Proportion to the Quantity of Human Ignorance. The Improvements made within these 2000 years, considerable as they are, would have been much more so if the Ancients had possessed one or two. Arts now in common Use I mean those of Copper Plate = and Letter = Printing. Whatever is now exactly delineated and described by those, can scarcely (from the Multitude of Copies) be lost to Posterity. And the knowledge of small Matters being preserv'd gives the Hint, and is sometimes the Occasion of Great Discoveries, perhaps Ages after.

The French War, which came on in 1744, took off our Thoughts from the Prosecution of my Proposal for Promoting useful Knowledge in America; and I have ever since the Peace been so engag'd in other Schemes of various kinds and in publick affairs, as not to find Leisure to revive that useful and very practical Project. But if I live to see our present Disturbances over in this Part of the World, I shall apply myself to it with fresh Spirit, as beside the good that may done, I hope to make myself thereby a more valuable Correspondent.

You will greatly oblige me by the Communication of the Inventions and Improvements you mention. And as it is a Maxim in Commerce, That there is no Trade without Returns, I shall be always endeavouring to ballance Accounts with you, tho' probably never able to accomplish it.

I am, Sir
Your most obedient
humble servant, B. FRANKLIN.

William Shipley, Esquire.

Philada June 15, 1756.

SIR,

The above is a Copy of my Letter sent you last year, to which having received no answer, I imagine it by some means miscarried. I shall write to my Friend and Correspondent Mr. Collinson to pay the 20 guineas therein mentioned to your Treasurer Mr. Goodchild.

I am Sir
Your most hume Servt
B. FRANKLIN.

My Respectful Compliments
to the Members of your Society.

The original letter does not appear to have been received, but the renewed communication was read at a meeting held on August 18, 1756, and it was "Order'd that a letter be sent to Mr. Franklin to return him thanks for his letter and generous offer." Further, "That Mr. Franklin's letter be preserved in the Guard Book," where it is now to be found. In the following year Franklin was in England and present at the Society's meeting on September 7, 1757, when he "read an extract of a letter to him from Mr. John Hughes, merchant of Philadelphia, as follows:— "Therewith put in your hands thirty-two dollars which I desire you'l present to the Society you mentioned to me some time ago, and be pleased to let them know I commit it to their direction to be laid out either for the good of Great Britain or America as they think proper;" which Donation was paid in by Mr. Franklin. "Order'd that the thanks of the Society be returned to Mr. Hughes for the above donation and also to Mr. Franklin for the trouble he had taken in this matter."

Franklin continued in constant communication with the Society, and in 1761 he was appointed Chairman of the Committee of British Colonies and Trade, being present at the meeting on December 9th, when this was brought forward, and in the minutes we read that "Dr. Franklin being present was pleased to signify his acceptance of the office."

Franklin was in London from 1724 to 1726 as a struggling compositor in a famous printing house. When he returned in 1757 he was not "a poor printer's boy" but, as Mr. John Bigelow, his biographer, says, "a messenger to the most powerful sovereign in the world from the corporate body of some of his most loyal subjects." He was settled, for some years in Craven-street, not far from the Society's meeting-place.

On October 29th, 1766, he wrote from Craven-street to Dr. Templeman, the Secretary of the Society, the following letter:—"I received with the enclos'd Letter an improv'd Compass for the Surveying of the Land sent me by Mr. Aaron Miller of New Jersey, with a request that I would lay it before the Society of Arts, which I will do whenever called upon for that purpose."

In consideration of the fact that the commemoration meeting just held in Philadelphia has been arranged by the American Philosophical Society, which was founded in 1743, it is interesting to note that in the Society's archives there is preserved in manuscript "A Proposal for Promoting Useful Knowledge among the British Plantations in America," dated Philadelphia May 14, 1743. The last paragraph of the paper reads as follows: "Benjamin Franklin, the writer of this proposal, offers himself to serve the Society as their Secretary till they shall be provided with one more capable."

It will be seen that this paper is dated before the formation of the Society of Arts. It was, however, read at a meeting on June 18, 1755, and is referred to on the minutes. "A plan, drawn up by Mr. Benjamin Franklyn, of Pennsylvania, was read and judged to be an excellent design, if it can be put in practice, for the Improvement and Communication of Science amongst the British Colonies in America, and for carrying on literary correspondence in Europe, but this not being sent to the Society by Mr. Franklyn, nor coming within ye plan of this Society, no other notice could be taken of it than to order it be preserved."

THE SMYRNA FIG TRADE.

The Smyrna fig district is largely along the line of the Smyrna-Aïdin Railway. The best grades of fruit, termed "erbeïlli," come from Inovassi. Figs from Naali and from Sultan Hissar are also highly valued, although the skins are somewhat thicker. Trees begin to bear in their sixth year, and are in full vigour in their fifteenth year. Fig trees on the low plains yield fruit which is both larger and richer in saccharine matter. They often suffer, however, from an excess of moisture in unusually wet seasons, when groves on higher ground are less harmed, owing to the facilities for drainage. The fruit ripens about the middle of August, when it is picked and dried in the open air for from three to six days. It is then packed in sacks of about 250 lbs. each, two of which constitute a load for a camel, and transported to the nearest railway station. After arrival at Smyrna camels likewise transport the sacks to the warehouses of the dealers. Carts are not employed in this connection, as the fruit is liable to be damaged when the sacks are piled one upon the other. The arrivals from the country are promptly bought up by the various great packing houses, which have each a large number of *employés*—chiefly women and girls—for the operation of sorting, washing, drying, and packing the fruit. This means work for many thousands in Smyrna during the months of September and October, and the average degree of prosperity among the lower classes during the entire year is largely dependent upon the amount of money set in motion during this short

period. The United States Consul at Smyrna says that the sorting of the figs is carried out with great care Colour, but more especially size and thickness, or rather thinness of skin, guide the classification. The inferior grades, the "hordas," culls, or refuse, are eliminated and sold for purposes of distillation. A certain quantity of this grade is exported to Austria and Hungary, and used as a substitute for chicory. The delicate flavour of Vienna coffee is said to be due to the presence of dried fig powder. The better grades are prepared for export in various ways. The least expensive is packing in linen or other bags, and is used for the less valuable qualities. The finer grades are subjected to a certain manipulation before being tightly packed in boxes containing from one to eleven pounds. During the manipulation the workmen continually dip their fingers in sea-water. As a result the fruit is better preserved and the sweetness is not diminished by long keeping. The term "macaroni figs" is applied to fruit which has been gently rolled between the palms of the hand, so as to resemble an elongated ellipsoid. "Loucoum figs" are prepared by pressing the fruit into a rectangular form, not dissimilar in size and appearance to the Oriental confectionery well known under the name of "Turkish delight." The great majority of the choicer figs, the so-called "oleme" (selected) are packed in layers. The upper side is split, and the fig is flattened out. This method allows expert manipulators to give a more presentable appearance to small figs than is possible in preparing "macaroni" or "loucoum" figs. The "macaroni" style of packing involves the least disturbance to the internal structure of the fruit. The "loucoum" style leaves it most nearly the original size, and is the best adapted for any subsequent manipulation by importers. The latter two methods are the most favourable for proper curing during transportation. Boxes of figs prepared by any of the three latter methods are usually exported in crates holding about 330 pounds. The Smyrna fig crop of 1905 was exceptionally large—over 20,000 tons—but it was all sold at good prices. There is much speculation in the trade, and a good share of the crop is sold long before being picked.

RAILWAY EXTENSION IN ASIATIC TURKEY.

The United States Consul at Smyrna states that the purchase of the Mersina-Adana Railway by the Anatolian Railway Company means the increasing importance of Mersina as a seaport, through which will flow the trade of Mesopotamia and the upper Euphrates Valley. The Anatolian line is now in operation from the docks at Haidar Pasha, opposite Constantinople, *via* Afioun, Kara Hissari, Konieh, and Eregli to Bulgurlu, a distance of nearly five hundred miles, and within seventy-five miles of Adana, where it will connect with the newly-acquired line to Mersina. From Adana the railway will push on towards Bagdad. Trade now finding an outlet at Alexandretta will naturally be diverted to the railway port of Mersina, or hurried by rail to Haidar Pasha, ferried across the Bosphorus, thence to the Oriental railway running northward to Vienna, &c. Smyrna may also come in for a larger share of this Asiatic trade, as railway connection exists between Smyrna and Afioun Kara Hissari, on the Anatolian Railway. The new dock construction of Smyrna, rapidly nearing completion, will provide for an enormous volume of traffic. It is also stated that the new French railway from the port of Beirut to Aleppo will be finished within a year. The Anatolian Company will also build a branch line south to Aleppo from their main railway to Bagdad. Beirut is also the terminus of the present line to Damascus, which is extending to Mecca. Great progress is being made in the construction of the Hedgas Railway, which is now open to traffic as far as Minlavéré, a point 95 miles beyond Ma'an, according to recent reports. The Dera-Haifa branch is in full working order, and this, together with the main line, makes 465 miles over which trains now run. The earthworks have been pushed beyond Mundavéré, and the survey has been completed as far as Medain Salih, 620 miles from Damascus, or considerably over halfway to Mecca. It is added that the Imperial Government intends to establish big engineering works, probably at Damascus, in connection with the railway, and has, it is said, ordered the necessary plant.

GERMAN PORCELAIN.

The successful experiments of Johann Frederich Böttcher resulting in the invention of Saxon porcelain early in the eighteenth century, were not without a direct influence upon the present prosperity of Thuringia. Several influences contributed to the establishment of porcelain factories in Thuringia, as King Frederick of Prussia had works at Berlin, so did the King of Saxony possess the celebrated manufactories of Meissen, and their example was followed by the Sovereigns of the several States and principalities. It was not, however, until the latter part of the eighteenth century that, encouraged by the sovereign authority, grants of land for prospecting purposes, and practically free wood fuel, primitive works were established in Thuringia. The natural resources of the district, that is to say a suitable clay and an abundance of wood for fuel purposes, supplemented by the reigning sovereigns, and in the granting of monopolies, the low cost of raw materials, the high prices obtainable for the finished article, all gradually brought about a condition profitable and satisfactory at least to the producer. In those early days, Steinheider clay was used in all the factories and was obtained

near a small hamlet of that name in Thuringia, near Sonneberg. The output of the factories was infinitesimal, very expensive, and of decidedly poor quality. The American Consul at Weimar states that intense ignorance prevailed as to the art and the technical details of manufacture, and such of the secrets of process as existed were handed down from generation to generation of employers and retained as a family asset. Up to 1870 technical men were not employed, but from that year dates the remarkable progress in the art which has made Germany the competitor for the world's trade. The successful conclusion to the war with France marked an advance probably without parallel. In it the manufacture of porcelain kept pace with the march of progress. Technical schools were opened and at the present time are well attended. A conservative estimate places the number of porcelain factories of prominence in Thuringia at 50, giving employment to 13,000 hands. The value of the total annual output varies from £1,000,000 to £1,400,000. The best market for Thuringia porcelain is the United States, followed by the United Kingdom and Germany itself. While the bulk of the manufactured articles are of the cheaper standard qualities, the ornamental china of Thuringia ranks with the best of Germany's productions, and has, it is said, but few foreign equals. In this connection, the Consul says that prior to the "country of origin" requirements, many Thuringian wares were presented for sale in the United States as of French origin. Good models, great variety of articles, and cheapened prices may be considered the principal causes of the remarkable increase which of late years is apparent in the demand by foreign markets.

GROWTH OF THE SUGAR INDUSTRY IN MEXICO.

The State of Vera Cruz has lately developed into an important sugar-producing territory. In the year 1900-1901 412 tons of sugar were exported from Vera Cruz, the United States having taken almost the entire output, less than two tons having gone to other countries. During the fiscal year 1899-1900 only a little over one ton was exported, though the total production in the entire Republic was estimated at 80,000 tons, and sugar to the value of £2,500 was imported. In 1901-2 not a single shipment of sugar passed through Vera Cruz to foreign parts, but in 1902-3 the business began to assume large proportions, and 8,250 tons were exported, of which amount the United Kingdom took the bulk, the United States only receiving about one-eighth of the total. In 1903-4 every sugar estate in the Republic was busily engaged in grinding, turning out mainly muscovado and centrifugal of 96 per cent., for the English market. The estimate of the production for that year was 15,000 tons, while the estimate of the production in 1904-5 was 30,000 tons. The American Consul at Vera Cruz says it is evident that the sugar industry of Mexico has attracted the attention of many persons, for inquiries are frequently received by him for information concerning the industry, from the cost of land to the cost of production. Mexican statistics show that in 1904, 38,668 acres were planted in sugar-cane in the following eighteen counties in the State of Vera Cruz:—Acayucan, Coatepec, Cordoba, Cosamaloapam, Chicontepec, Huatusco, Jalcingo, Jalapa, Minatillan, Misantla, Orikaba, Ozuluama, Papantla, Tantoyuca, Tuxpam, Vera Cruz, and Zongolica. The yield of sugar depends upon the position of the plantation. On the higher levels it is not so great as in the hot lands. From 26 to 45 tons of cane per acre in the higher lands would be a fair production. The saccharine matter from this quantity of cane is 65 per cent. of the weight of the cane, and the quantity of white centrifugal sugar produced runs from 7½ to 10 per cent. or over—say about 130 to 150 pounds of sugar per ton of cane. Nothing definite can be said as to the value of the lands. Wild uncultivated lands suitable for planting cane cost from 12s. 6d. to £2 and more per acre, but improved lands vary much in value, according to situation, degree, and kind of development, transportation facilities, and improvements. Land may be cleared and planted in cane at a cost of about £5 per acre. There are no irrigation works in the State of Vera Cruz; such systems as are in operation are privately managed, and no official records of their operations exist. The labour required is also a variable quantity, governed entirely by local conditions, methods employed, distances on the plantation, &c., but chiefly by the location. In the hot lands the harvest is short and a large number of men are required to gather in the cane, while up in the higher ranges the harvest continues much longer and fewer men are required, although these work for a longer time. In the cooler regions, however, the cane must be replanted every two or three years, and in the hot lands only every ten to twelve years. Labour, by reason of its scarcity, commands a higher price in the hot lands than in the more elevated and populous districts. In the latter from one shilling to one shilling and threepence a day is paid, while on the isthmus the daily wage runs from two shillings to two shillings and sixpence. All field labour is arranged on a piece-work basis; that is to say, a labourer receives a certain price for the performance of a given amount of work or task. Naturally this price will vary in accordance with climatic conditions, being higher in the hot country than in the cooler regions. Although the cane is taller in the former, the weeds are much more troublesome. On the uplands about elevenpence is paid for the planting of 400 square yards in cane. For cleaning the cane fields, which has to be done four or five times before the cane is cut, about ninepence is paid for from 300 to 400 square yards, but this depends altogether on the condition of the plantations.

HOME INDUSTRIES.

San Francisco and British Insurance Losses.—The estimates of losses incurred by the British insurance companies in connection with the partial destruction of San Francisco, can only be accepted with great reserve. It may, however, be taken as certain that the losses are very heavy. San Francisco has been a favourite field for British insurance enterprise. Its average of serious fires has been much lower than that of most large American cities, owing probably to the comparative fewness of stoves in use in winter, whilst the moist winds from the Pacific are said to lessen the danger from wooden structures. Taking the revenue collected from San Francisco and its neighbourhood by British offices during the past year, as nearly as it can be got, the entire liability of the leading British companies would seem to be about £20,000,000, but if the liabilities in the outlying districts, not involved in the disaster, are allowed for, and exemption for the loss sustained by the fall of buildings, for which the offices are not liable, the actual liability will probably work out at something under £10,000,000. However that may be, the British offices will pay promptly and without quibbling, as they did after the great Chicago, Baltimore, and Boston fires, much to their ultimate advantage. If they were disposed to do so they might raise some very nice points as to their liability. Admittedly, they are not liable as to damage done by earthquake, and it might well be urged that they are equally exempt from the consequences of occurrences due to earthquake. But they will remember that the business of the insurer is to protect the insured, and not to take advantage of mere technicalities. There will, no doubt, be an understanding with the leading American insurance companies involved as to the broad basis of payments. A narrow interpretation of obligations would be, to put it on the lowest ground, bad business, and however heavy the losses of both American and British offices they will find consolation in the certainty that prompt payment of claims, and waving of technical objections, will bring them a big increase of new business. At the same time, the gigantic disaster at San Francisco, with its attendant losses, can hardly fail to deepen the disinclination of some British offices to push American business with its very exceptional risks. And with every desire to meet obligations promptly, it is not to be expected that British insurance companies will pay losses before they are adjusted, or go beyond their contract, whatever that may be.

Coal Exports.—It is computed that the French strikes, which bid fair to spread rather than cease, account for some 600,000 tons of coal purchased out of the ordinary run of business. The situation in America, too, remains very critical, so that if serious labour troubles can be avoided here the present should be a prosperous year for the collieries. Our exports of coal to France have been decreasing for some years. In 1900 we exported to that country 8,635,030 tons, of a value of £6,993,387, but each year since the export has been smaller. In 1904 it was only 6,927,103 tons, of a value of £3,534,503, or only a little more than half the value of the 1900 export. German competition is felt in increasing degree. The foundation, organisation, and methods of the Rhenish Westphalian syndicate, aided by preferential railway tariffs and cheap water carriage, constitute formidable competition. The export of coal from the United States continues to be of comparatively small importance and the competition of American coal has only as yet affected our distant markets, but there is reason to think that before long American production will far outstrip the local demands, and that it will become necessary for the Americans to establish a large coal export trade in order to dispose of their surplus. In 1904 the exports of coal from the United States amounted to only 2,225,392 tons, the enormous quantity of 312,334,489 tons being consumed in the country. This enables one to realise to a certain extent the immense development of the manufacturing industry of the country. With us, on the contrary, the home consumption shows no considerable expansion, the principal growth has been in the export trade.

The Egg Trade.—Why is it that our trade with Canada in eggs not only shows no expansion but is rapidly diminishing? We first began to import eggs from Canada in 1875, but there was no considerable expansion for some years, and in 1889 the import dwindled to 98 dozen. Then it began to move upwards until in 1902 we imported 11,353,825 dozen. Since then, however, the imports have fallen continuously, and last year they only amounted to 3,352,485 dozen, of a value more than 1,000,000 dols. less than the import of 1902. Nor does it seem that the Canadian export trade in eggs has been diverted, for the export of Canadian eggs to other countries than England remains, as it has always been, quite insignificant. Perhaps the explanation of the falling off may in part be found in the assertion of a Leeds salesman to Mr. J. B. Jackson, the Commercial Agent of the Dominion in Leeds, who, reporting to his Government under date February 9 last, as recorded in the most useful weekly report issued by the Department of Trade and Commerce Ottawa, quotes the salesman as saying: "The demand for Canadian eggs is not what it should be when we contrast it with the demand for other Canadian produce. I cannot give you any reason why, but somehow my customers are chary of buying them. Perhaps the fault lies in the fact that they have never been pushed by the wholesale houses like Russian and Irish eggs, and this make the small retailers afraid of buying something out of the common, or perhaps the responsibility rests with the Canadians themselves, in not making these products known in this district. Whatever the reason is, the packing

is not to blame; bnt Canadians should not ship too many pickled eggs. We get enough of those from the Continent. Glycerined eggs are the class of goods which always have the biggest demand."

The Cheese Trade with Canada.—And so with Canadian cheese in a lesser degree. If we compare the quantity of cheese and its value imported into the United Kingdom from Canada in 1895 and 1905 great expansion will be shown. In 1895 we took from Canada 145,726,022 lbs., valued at £14,220,505; in 1905 we took 214,744,150 lbs., valued at £20,300,500; but if we compare 1903 with 1905 we find that in the earlier year we took 228,394.482 lbs., of the value of £24,620,004, as against the figures quoted above for 1905. The difference in the value of the imports of cheese between 1904 and 1905 amounted to over £1,800,000. We turn again to the Leeds salesman, quoted by the Canadian Commercial Agent, and find him saying—"Canadian cheese is the best in the market. Everyone knows that. My own firm imports 90 per cent. of all the cheese we sell from Canada; but why don't Canadians make their cheese a little softer and more crumbly, so that when it is cut into it is about as near an approach to a lot of bread crumbs as possible? This is the style of cheese that the Yorkshireman likes, and this is what he asks for, and when he gets it he will take no other." Tastes differ, but the Canadian producer might find it to his advantage to have some regard to Yorkshire idiosyncrasies. And if the cheeses were smaller, averaging, say, between 30 and 40 lbs., they might find a readier sale. Retailers have not always an immediate demand for the big cheeses as they cannot get through them quickly to stock regularly.

The Motor Industry.—The great risks, from the commercial point of view, run by companies formed for working motor-omnibuses have been frequently pointed out in these Notes. The industry is in its pioneer stage, and whilst the old horse omnibus companies are compelled by the necessities of the situation to spend immense sums in putting motor-omnibuses upon the streets, they do so in the knowledge that although they may select the best motor omnibus on the market, it is more likely than not that before their orders are completed, or very soon afterwards, they will have to reckon with rival companies working an admittedly superior patent. What are the main objections to the motor-omnibus as it is seen upon the streets to-day, objections affecting the traveller, the shareholder, and the general public? There are three main drawbacks associated with the petrol motor: (1) disagreeable smell, (2) noise, (3) frequent breakdowns. Now, if any, much less all, of these drawbacks can be got rid of it is obvious that the company working the improved vehicles will be at a great advantage as compared with the older companies. It is pretty certain that all of them will be got rid of ultimately, and already a company has been formed to run electric omnibuses which are said to be exempt from all these drawbacks. It is claimed for the electric 'bus that it is absolutely noiseless, that it is without smell and smoke, that it is safe from fire, and that no explosion is possible, that there is no vibration, that it runs with the ease and smoothness of an electric brougham, that wear and tear is much less, that the capital cost of the electric 'bus charges is 20 per cent. less than the petrol charges, and that it can be worked much cheaper. Without expressing an opinion as to whether all or any of these advantages can be substantiated—and it is very unlikely that all of them can be—the fact that a company has been formed to run these electric motor 'buses illustrates the extreme risks attached to motor-omnibus enterprise in this transition period. If the electric 'bus does half it claims to be able to do it must run the petrol 'bus off the road, and when it has succeeded in doing that it may have to reckon in its turn with some new improvement that will make its own vehicles obsolete. In the old days those who catered for street passenger traffic had only to see to it that they had the best constructed 'bus, and the cost of possible changes in their construction was a mere bagatelle as compared with what the same caterers have to reckon with now that horse traction is disappearing. Reduction in working expenses is a matter of vital moment if the motor omnibus is to be more than an auxilliary and a feeder to the electric tramway. Where tramway competition is not allowed, as in Central and West London, the motor omnibus has an immense future before it, but it may be doubted whether any conceivable service of omnibuses could carry the traffic now borne by many tramways. An omnibus holds so few passengers as compared with a tram-car that to supply the wants of a busy time the streets would be filled with the omnibuses necessary. It has to be remembered, too, that whilst the working expenses of the tram car do not increase as rapidly as the mileage run, the working expenses of the motor omnibus, as at present known, tend to increase in almost direct proportion to the mileage run. It follows that the tramway can afford to give the public a more frequent service even though the cars are often far from full. But whilst it is obvious that in certain busy centres the low working expenses of the tram car enables it to defy competition, the omnibus rivalry must become very serious in many places if the smell, noise, and chances of accident are greatly diminished. In country districts, too, the motor omnibus bids fair to effect great changes, and to secure for itself an immense traffic as feeder of the railways, and a passenger carrier where the electric tramway is impossible.

Iron and Steel Industries.—Some remarkable figures are given by a correspondent of *The Times* as to the iron and steel industries. In the manufacture of pig iron before 1880, England was pre-eminent. The product was 50 per cent. more than that of the United States and Germany combined. Ten years

later, the former country produced more than England, and the United States and Germany together twice as much. Eight years later (1903) Germany produced more than England, while the United States alone produced twice as much as England. Or to put the matter in another way. In 1880, England produced 45 per cent. of the world's make, Germany 15 per cent., the United States 14 per cent. In 1903, the United States produced 39 per cent., Germany 20 per cent., and England only 19 per cent. With steel, the case is even worse. Since 1880, steel has replaced wrought iron in nearly all manufactures, and in 1880, the United States and Germany manufactured about 30 per cent. less than England. In 1888, the United States equalled England. Five years later, Germany nearly equalled, and the United States largely exceeded England. About 1898, Germany's manufacture was much greater than that of England, and America's manufacture three times as great. Or, put in another way, between the dates given the manufacture of steel in England increased $4\frac{3}{4}$ times, in Germany thirteen-fold, in the United States seventeen fold. These figures show that during the last twenty-five years England has receded from a position of great pre-eminence to the lowest place among the three great steel-producing countries. On the other hand, between 1900 and 1905, the importation of iron and steel into England increased very largely, the importation in 1905 being 1,435,000 tons, as against 741,402 tons in 1900. The importation of motor-cars and cycles show an even more remarkable increase. The value of these imports in 1902 was £1,103,000; in 1905, £3,447,000. These are very remarkable figures. Whether protection would improve matters, as the correspondent argues, is another matter, and one which it does not come within the province of this column to discuss.

OBITUARY.

James Mackenzie Maclean.—Mr. Maclean, the distinguished journalist and politician, died at Bournemouth, on Sunday, 22nd inst., after a severe paralytic seizure. He was born at Edinburgh in 1855, and began his journalistic career on the staff of the *Newcastle Chronicle*, of which newspaper he was editor from 1855 to 1858. In 1859, he went to India as editor of the *Bombay Gazette*, and did not return permanently to England until 1879. During his residence in India he took an active interest in municipal affairs, and for a time he held office as Chairman of the Town Council of Bombay. He was also Fellow of the University. He was M.P. for Oldham from 1885 to 1892, and for Cardiff from 1895 to 1900. In 1896 he held the office of President of the Institute of Journalists Mr. Maclean was elected a Member of the Society of Arts in 1881, and he served on the Council from 1883-86. He was also a member of the Committee of the Indian Section. He read papers before this section in 1882 on the "Results of British Rule in India;" in 1884, on "State Monopoly of Railways in India;" in 1900, on "New Projects of Railway Communications with India;" and, in 1903, on "India's Place in Imperial Federation." For the first and last-named papers he received the Society's silver medal.

GENERAL NOTES.

The Trieste Commercial Museum.—In his report on the trade and commerce of Trieste for 1905 (No. 3550, Annual Series), Mr. Consul Spence refers to the Commercial Museum (to be known as "Il Museo Commerciale di Trieste") about to be opened in that city. It is on the model of those existing in several other large commercial centres. In addition to the information bureau and library (furnished with the principal commercial publications, trade journals, catalogues, &c., in several languages, there will be an exceedingly well arranged and comprehensive collection of samples of goods and produce, also of the testing apparatus employed in different trade markets, such as that for determining the specific weight of grain, the alcoholic strength of wine, the flash point of petroleum, &c., the specific weight of pepper, according to London standard, the polarisation of sugar, aud the weight of oils (vegetable and mineral), &c. A journal will be issued. Mr. Spence repeats the advice given by his predecessor in his report for 1904, namely, that British merchants would find it to their advantage to print the price lists, catalogues, &c., issued for the Trieste market in the Italian language, which, although German in the official language, is the one more generally employed among the commercial classes.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

May 2.—"Submarine Signalling." By J. B. Millet. Sir William White, K.C.B., F.R.S., will preside.

May 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By Professor Thomas Oliver, M.D., LL.D. Henry Graham Harris, Member of the Council, will preside.

May 16.—"The Development of Watermarking in Hand-made and Machine-made Papers." By Clayton Beadle. Sir Francis Haydn Green, Bart., will preside.

May 23.—"The General Supply of Electricity for Power and other Purposes." By James N. Shoolbred, B.A., M.Inst.C.E. Sir William H. Preece, K.C.B., F.R.S., in the chair.

Indian Section.

Thursday afternoons, at 4.30 o'clock :—

May 24.—Major Percy Molesworth Sykes, C.M.G., H.M.'s Consul-General at Meshed, "The Parsis of Persia."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock :—

May 1.—"Social Conditions in Australia." By the Hon. J. G. Jenkins, Agent-General for South Australia.

Applied Art Section.

Tuesday Evening, at 8 o'clock :—

May 8.—"Damascening and the Inlaying and Ornamenting of Metallic Surfaces." By Sherard Cowper-Coles.

May 29.—"Glass Cutting." By Harry Powell.

*** This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

Alfred Maskell, "Ivory in Commerce and the Arts." Three Lectures.

Lecture II.—April 30.—Early Christian and early Byzantine ivory sculpture—Uncertainty of the origin and dating of certain type pieces—Examination of the methods of recent German commentators—Examples considered (amongst others): British Museum Passion Plaques; Munich and Liverpool "Ascensions;" B.M. Pyx or vase with cover; B.M. archangel; Ravenna chair; Carrand diptych; Lorsch bookcovers; Brescia casket; Bodleian bookcover; South Kensington bone plaque with "Magi;" Alcester tau; and others—An attempt to throw light on some obscurities and difficulties from a different point of view to that usually accepted. (Illustrated by lantern slides and casts.)

Lecture III.—May 7.—Applications and uses of ivory in the industrial and decorative arts—Religious statuettes and figures of mediæval times—Pastoral staves and other liturgical accessories—Caskets, marriage coffers, mirror cases, combs, and other domestic articles — Arms and hunting horns — Tankards—Tobacco graters — Portrait medallions — Chessmen and draughtsmen and boards—Ivory sculpture in India, China, Japan—Musical instruments—Furniture and inlaid work—The working of ivory: the lathe and turnery—Forgeries of works of art—Ivory sculpture at the present day in France, Belgium, and England—The position of ivory sculpture, with a plea for its encouragement. (The lecture will be illustrated by examples and by numerous slides.)

MEETINGS FOR THE ENSUING WEEK.

Monday, April 30...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. Maskell, "Ivory in Commerce and in the Arts." (Lecture II.)

Farmers' Club, 5, Whitehall-court, S.W., 4 p.m. Mr. Joseph Fils, "Farm Colonies."

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m.

Tuesday, May 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p m. (Colonial Section.) Hon. J. G. Jenkins, "Social Conditions in Australia."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. G. Baldwin Brown, "Greek Classical Dress in Life and in Art." (Lecture II.) 5 p.m. Annual Meeting.

Central Chamber of Agriculture (at the House of the Society of Arts), John-street, Adelphi, W.C., 11 a.m.

Alpine Club, 23, Savile-row, W., 8½ p.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Wednesday, May 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. J. B. Millett, "Submarine Signalling."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. 1. Mr. Alfred Fryer, "Notes on Fonts." 2. Mr. Talfourd Ely, "Excavations in Hayling Island."

British Archæological Association, 32, Sackville-street, W., 4.30 p.m. Annual Meeting.

Obstetrical, 20, Hanover-square, W., 8 p.m.

African Society, Criterion Restaurant, Piccadilly, W., 9 p.m. Sir Harry Johnston, "Liberia."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (James Forrest Lecture.) Mr. Robert Abbott Hadfield, "Unsolved Problems in Metallurgy."

Thursday, May 3...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m.

Chemical, Burlington-house, W., 8½ p.m. 1. Messrs. E. C. C. Baly, E. G. Marsden, and A. W. Stewart, "The Relation between Absorption Spectra and Chemical Constitution. Part V. The Isonitroso Compounds." 2. Messrs. W. H. Perkin, jun., and J. L. Simonsen, "The Action of Tribromopropane on the Sodium Derivative of Ethyl Malonate. Part II." 3. Messrs. P. Engels and W. H. Perkin, jun., "Brazilin and Hæmatexylin. Part VII. Some Derivatives of Brazilein." 4. Mr. J. M. Sanders, "Pipitzahoic Acid." 5. Mr. C. K. Tinkler, "The Constitution of the Hydroxides and Cyanides obtained from Acridine, Methyl-acridine and Phenanthridine Methiodides." 6. Messrs. E. M. Rich and M. W. Travers, "The Constitution of Ammonia Amalgam." 7. Mr. G. W. A. Foster, "Action of Light on Potassium Ferrocyanide."

Royal Institution, Albemarle-street, W., 5 p.m. Dr. P. Chalmers Mitchell, "The Digestive Tract in Birds and Mammals." (Lecture II.)

Friday, May 4...Royal Institution, Albemarle-street, W., 9 p.m. The Hon. C. A. Parsons, "The Steam Turbine on Land and at Sea."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Heraldry."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m. Annual Meeting.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Saturday, May 5...Royal Institution, Albermarle-street, W., 3 p.m. Prof. C. Waldstein, "English Furniture in the Eighteenth Century." (Lecture II.)

Journal of the Society of Arts.

No. 2,789. VOL. LIV.

FRIDAY, MAY 4, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 7, 8 p.m. (Cantor Lecture.) ALFRED MASKELL, F.S.A., "Ivory in Commerce and in the Arts." (Lecture III.)

TUESDAY, MAY 8, 8 p.m. (Applied Art Section.) SHERARD COWPER-COLES, "Damascening and the Inlaying and Ornamenting of Metallic Surfaces."

WEDNESDAY, MAY 9, 8 p.m. (Ordinary Meeting.) PROFESSOR THOMAS OLIVER, M.D., LL.D., "Bridge-building by means of Caissons, including remarks upon Compressed Air Illness."

Further details of the Society's meetings will be found at the end of this number.

APPLIED ART SECTION.

The meeting of the Section on Tuesday evening, 29th inst., when Mr. HARRY POWELL will read a paper on "Glass Cutting," will be held at the Whitefriars Glass Works, Tudor-street, E.C., by the kind permission of Messrs. James Powell and Sons.

The accommodation is strictly limited, and 100 tickets only will be issued. These tickets will be issued in order of application to members until the number is exhausted. Each member is entitled to apply for one ticket, which will be transferable.

No one can be admitted without a ticket.

CANTOR LECTURES.

On Monday evening, 30th April, Mr. ALFRED MASKELL, delivered the second lecture of his course on "Ivory in Commerce and in the Arts."

The lectures will be published in the *Journal* during the autumn recess.

COLONIAL SECTION.

Tuesday afternoon, May 1st; SIR THOMAS FOWELL BUXTON, Bart., G.C.M.G., late Governor of South Australia, in the chair.

The paper read was "Seistan: Past and Present," by COLONEL SIR HENRY McMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission.

The paper and report of the discussion will be published in a future number of the *Journal.*

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

TWENTIETH ORDINARY MEETING.

Wednesday, May 2nd, 1906; SIR WILLIAM WHITE, K.C.B., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Beale, Octavius Charles, Howard Hotel, Norfolk-street, Strand, W.C.
Liberman, H., Town-house, Cape Town, South Africa.
Mackrell, John, High Trees, Clapham-common, S.W.
Mole, Miss Mary, 49, Baker-street, W.
Parker, Charles E., Penketh-lodge, near Warrington.
Rose, Arthur Veel, 24 West 59th Street, New York City, U.S.A.
Takahashi, Korekiyo, The Bank of Japan (Nippon Ginko), Tokyo, Japan.

Williams, Henry Sylvester, 5, Essex-court, Temple, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Elliott, W. R., Forestry Officer, Lokoja, Northern Nigeria, West Africa.
Tierney, J. Wilbur, Ashtree, Beulah-hill, S.E.

The paper read was—

SUBMARINE SIGNALLING BY MEANS OF SOUND.

By J. B. Millet.

I remember an old pilot telling me that his grandfather, who had been a pilot before him, was wont, in foggy weather, to go down into the hold, and, with his ear to the skin of the ship below the water line, would listen for the sound of the paddles of passing steamers. To-day the masters of our greatest steamships are listening with ears to the walls of their vessels, and it has been a triumph of modern science, not only to enable them to make their observations in the quiet seclusion of the chart house, but to demonstrate conclusively that, in the instinct of the old pilot, lay the fundamental principle of safety at sea.

I have before me, and will presently read to you, letters from the masters of many transatlantic liners bearing irrefutable testimony to the value of this latest aid to navigation. The discovery of transmission of sound through water is common knowledge to you all. With a speed four times faster than can be obtained by sound in air, and by reason of the unvarying density of its medium, sound submarine has for signalling purposes an advantage over aerial tones which is to-day receiving practical recognition in the seafaring community of the world.

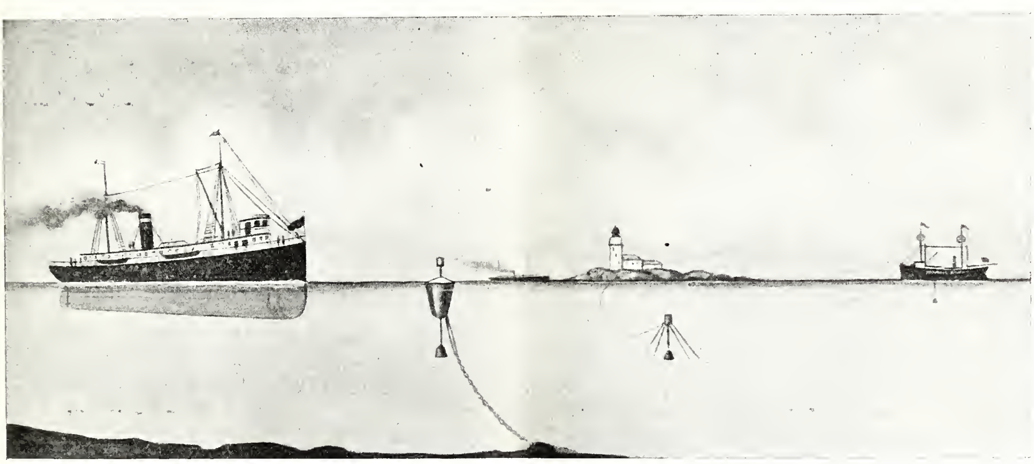
The history of the Submarine Signal Company had its birth in 1895, when the United States were at war with Spain. Mr. A. J. Mundy, one of the chief inventors, while sailing from New Orleans up the Mississippi River and sharing the general alarm created by the reported approach of Spanish torpedo boats, bethought himself of his youthful experience of hearing stones cracked together under water. With the principle of the telephone transmitter in his mind, he speculated whether the microphone could be utilised as a receiver of sounds under water. Not being himself an electrician, he wrote, on reaching St. Louis, to Professor Elisha Gray of Chicago, one of the pioneers in telephonic invention, and enlisted his assistance in devising a practical apparatus. Their investigations were carried on during the summer in the open sea near Boston, and the results obtained were such as to encourage the subscription of ample capital for continuing the work upon an extended scale. A scow large enough to be towed out to sea was built, and from it bells were suspended and rung for experimental purposes. A special shop was engaged and provided with a laboratory, and with all the machinery needed to make any apparatus that the inventors designed. The services of electricians, schooled in telephonic work, were engaged to devise a microphone adapted to use under water. This, in itself, was a most difficult undertaking, and was not successfully mastered for many years. As soon as the organisation of the working force was complete the inventors sought the assistance of leading professors of acoustics, and experts in aerial signals for the sea. But to their dismay they discovered that students of sound had confined their researches to the air and had little knowledge of the various principles of sound in water. Nor were any references to the subject to be found in text-books. The files of scientific publications were searched in vain for records of laboratory experiments with sounds submarine, so that the inventors were face to face with the necessity of depending upon their own unaided investigations. They reasoned quite naturally that whatever was true of sound in the air would be true of sound in water, but experience in time brought the conviction that it was most unsafe to trust to analogies between the two mediums. This made it imperative to construct and operate in the sea a large number of different forms of apparatus, in order to obtain results from which to lay down general lines of work. Everyone working on actual experiments had to be trained by experience in the sea before observations could be trusted. All this occupied several years, and was attended with great self-sacrifice and devotion to the cause, not to mention personal risk.

For my own part, I may say that to be suddenly called upon to turn from the peaceful trade of publishing to take charge of scientific research in an unknown and difficult field was somewhat terrifying. Death had overtaken Professor Gray in the midst of his work, and not long after, continuous anxiety to succeed,

combined with long hours of labour, undermined Mr. Mundy's strength, and he was obliged to abandon the work. For some time previously I had been associated with Mr. Mundy as vice-president of the company, and at this juncture the direction of affairs fell to me. I soon realised that only by making my home on the water, and, as it were, living with the problem, could I hope to acquire an intimate knowledge of submarine sound, and to apply along practical lines the somewhat unrelated strands of previous discovery. The nights and days of two summers on the water, innumerable winter voyages up and down the New England coast, in the open sea and in all weathers boarding and putting off from incoming ships—always listening and testing results — these experiences brought at length in their train a knowledge of sounds of sea and ships, which I now feel to be little less than instinctive. To this knowledge, and to this alone, I owe the inward confidence which has never deserted me in the face of difficulties and discouragements that have proved many times all but insurmountable to others. Neither criticisms from those who had a right to be regarded as experts in nautical matters, nor adverse reports from some whose lukewarm interest proved a hindrance rather than a help, nor yet the opposition of others who hoped to find a fallacy in the principles involved,—none of these could shake a confidence founded upon such an extended experience.

The earliest attempts to invent apparatus which would enable ships to detect submarine signals, contemplated the fastening of a microphone to the outer walls of the vessel, or the lowering of it overboard. The latter seemed the more practical, and much time was lost in trying various kinds of so-called "fish receivers"; for it was believed that if the microphone were fastened inside the ship the noises of the engines and other machinery on a steamer would fill the receivers with a roar and drown the notes of the bell. A few rather hasty experiments in this direction seemed to confirm this belief; but when the towing apparatus turned out to be entirely impractical (for among other defects it could not locate the direction of the sound waves), the inventors were driven to solving the problem from the inside of the ship.

Fig. 1.



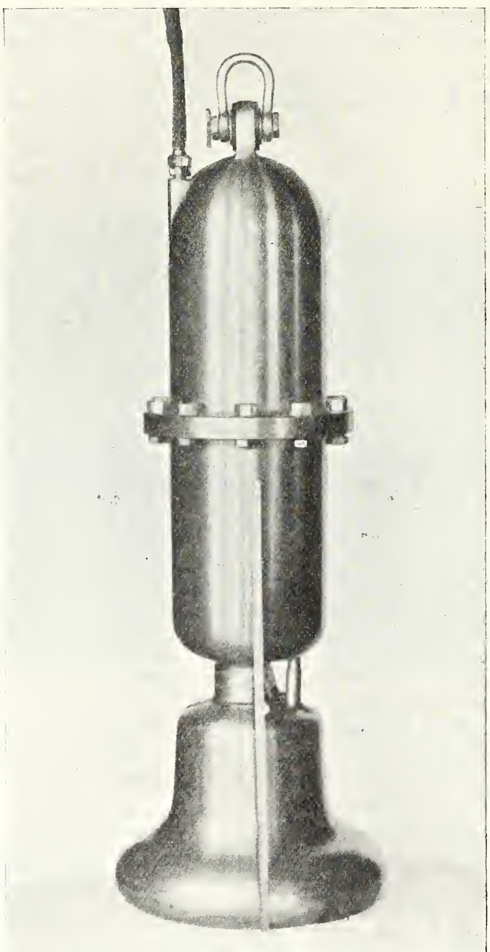
General View of the System.

Many years previous to this, Professor Lucien Blake, an American, who had been studying physics in Berlin, made the discovery in which lay the basis of practical submarine signalling. He found that bell sounds would pass readily from the water outside through the walls of floating structures. The old frigate *Constitution*, with its 22-inch oaken walls, proved to be an excellent conductor of submarine sounds. In order to carry on extended observations, arrangements were made for the use of four steamers of 3,000 tons each plying between Boston and New York, and permission was obtained from the United States Lighthouse Department to place submarine bells on three lightships on the route. From this time, the operations of the Company were

conducted along the lines which led us successfully to a practical system.

The existing sound-producing apparatus used by the Company is as follows:—First, a bell weighing 160 pounds operated by compressed air and perfected for use on lightships. This is suspended over the side of the vessel and lowered about 25 feet below the surface. The blows are controlled by a code-ringing

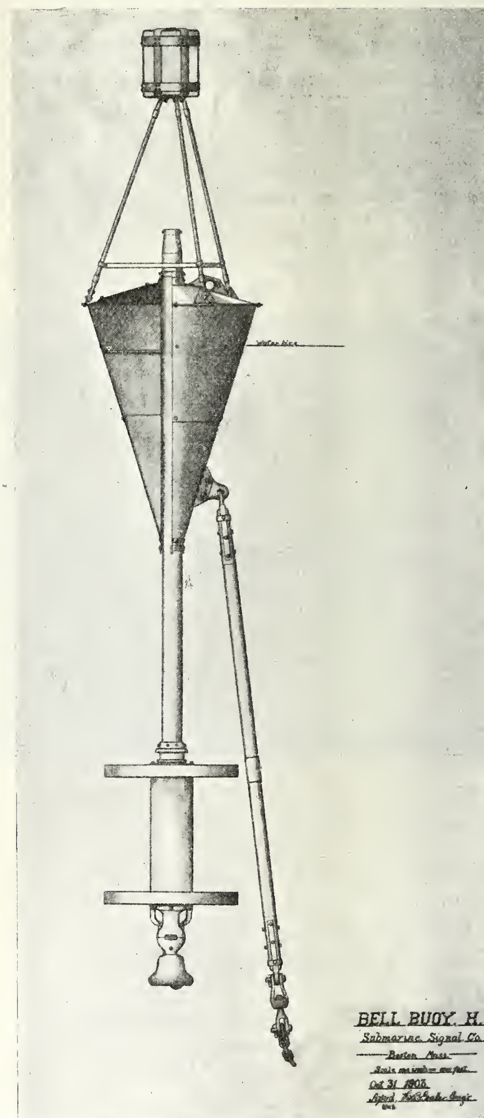
FIG. 2.



PNEUMATIC BELL.

device in the engine room, under the supervision of the officers, so that each lightship rings its own number. Second, a bell of similar weight, supported on a tripod placed on the floor of the ocean and operated by electricity sent along a cable from a powerhouse on shore. Third, a buoy supporting a submarine bell, some 25 feet below the surface. Situated above the bell is a disk working on the principle of a sea anchor; the difference in movement between this and the buoy operates a mechanism known as the "accumulator," by which the bell is struck with uniform force. On a calm sea the blows will, of necessity, be less frequent than when

FIG. 3.



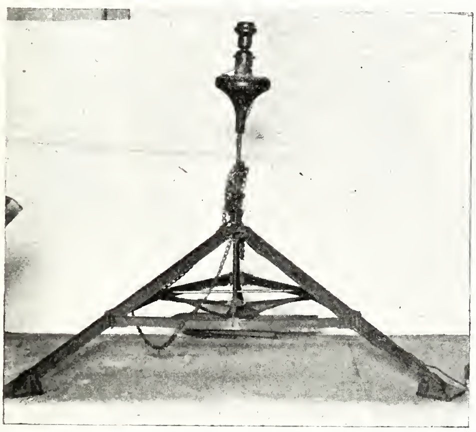
AUTOMATIC BELL BUOY.

the waves are larger, but a wave of only six inches in height will give sufficient energy to produce two blows per minute.

The tones of these bells have a range varying from six to twelve miles, according to the draught of the observing steamers. The pitch of the bells can be changed by altering the

thickness of the rim, or by increasing the diameter. Those used in the earliest experiments weighed 1,000 pounds, and were cast for church steeples. Practice showed that the higher overtones of these bells were weak, while those very notes possessed the most penetrating qualities. In order to strengthen these tones, bells less than one-half the diameter, and weighing only 150 pounds were cast, with a peculiarly thick lip, and these were found to produce a very high clear note. This diminution in the size, and decrease in the weight of the bell, greatly simplified the problem of designing a practical bell buoy. It was even found that a bell four inches in diameter gave a high tenor note that penetrated the walls of a steamer at a distance of

Fig. 4.



Tripod for supporting Electric Bell.

three miles. One of the puzzling results of experiments, was, that instruments which gave a poor musical tone in the air often proved singularly efficient in water.

Nothing in connection with this invention is more remarkable than the musical quality of the bell-note when passing through water and transmitted by a selective microphone. However attenuated by distance, I might say, however unexpected by the listener, the bell-sound when first heard is unmistakable. Amid the surge and hiss of the rushing water its high, clear tone is almost startingly isolated, and as the note becomes louder, with lessening distance, the sensation of a novice at the receiver is somewhat novel. And again, distance in no way makes the apparatus less trustworthy, were the listening ship suddenly to be lifted and dropped, heading in the same way, in the ocean five miles farther off, the bell-note, although fainter, would pass through the starboard and port transmitters with unaltered relative intensity.

The apparatus for receiving the sound consists, firstly of two metal tanks, about 22 inches square, filled with sea water, fastened securely against the skin of the ship below the water line, and not less than a demonstrated distance from the fore-foot. Secondly, a specially designed microphone suspended, wholly immersed, in each tank. Thirdly, wires connecting these microphones with an indicator box on the bridge. This box is of metal, circular in shape, and is fitted with two telephonic ear pieces, or receivers, enabling two observers to listen simultaneously. By moving a switch the listener can hear instantly the sounds of port or starboard at will. As a provision against accident, a second set of microphones is placed in each tank, and by manipu-

Fig. 5.

Lowering Tripod into Position.

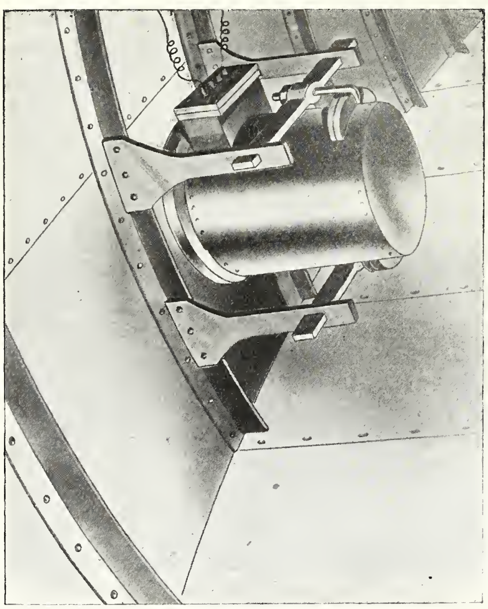
lating another switch on the indicator box, the operator is able to connect either set at will.*

The method of using the apparatus is remarkably simple. Let it be supposed that a ship equipped as above is coming within range of the sound of a submarine bell. The observer, with the receiver to his ear, listens to starboard and port alternately by quickly turning the requisite switch. Presently he hears the high, musical note of the bell, and referring to the face of the indicator, can tell from which side the sound emanates. He then connects with the other side, and if the note of the bell can be distinguished there

* Eighty-eight steamers and pilot boats on the Atlantic have already been equipped with the Submarine Signal Company's apparatus, including liners owned by the Cunard, White Star, Allan, Norddeutscher Lloyd, Hamburg American, Campagnie Transatlantique, as well as several warships of the United States Navy, amounting in all to a gross tonnage of 400,000 tons.

also, the observer knows that the ship is heading in the general direction of the signal. It then becomes his duty to compare, by turning the switch to and fro, the intensity of the bell notes on starboard and port sides. Experience has shown that by this method the bearing of the submarine bell can be rapidly determined to within less than a quarter of a point. Of course if the bell is a-beam or nearly so, the sound will be heard only on that side. These observations can be made when the vessel is proceeding at its full speed, and, under such

FIG. 6.



THE TANK.

conditions, signals have been often accurately located at distances up to ten nautical miles. In foggy or thick weather, when speed is reduced, the diminution in the ship's noises enables the observer to hear the bell at greater distances. These results are valuable, not only on account of the long range of the signal, but because the direction can be accurately determined under all weather conditions, whereas it is notorious that sound-signals in the air are wholly untrustworthy. A remarkable illustration of this fact recently came under my notice. A party of observers set out to test the sound-range of a siren on a lightship. The conditions were favourable — a calm sea and a clear, still air. The boat approached nearer and nearer the lightship, but not a sound reached the ears of the listening experts. At a distance of 600 yards, without the slightest warning, these gentlemen were all but deafened by an apparently sudden roar from the siren, which continued until they boarded the lightship. Enquiry amply proved that the instrument had been sounding at its full pitch, at frequent intervals, for over three hours.

I do not suggest, however, that sound-signals in the air should be superseded. Our invention is intended as an added aid to navigation.

That it has accomplished more than its

FIG. 7.

INDICATOR BOX.

supporters could have anticipated is proved by the notable position it now occupies in the commercial navigation of the Atlantic. The following letters have been received within the last six weeks:—

Translation.

Norddeutscher Lloyd,
Central Bureau.

Captain Hogemann, of the *Kaiser Wilhelm II.*, coming into Bremerhaven on February 27th, reports as follows:—

On the entrance of the *Kaiser Wilhelm II.*, today into the Weser, the submarine bell on the Outer Weser Lightship was heard with the starboard receiver one point to starboard at a distance of about 10 knots. There was a thick fog, with light S.W. wind and calm sea. The course was changed one point to starboard, whereupon the bell, after

this change of course, was heard only with the port receiver, so that it was evident the lightship must be located about one point ahead as a result of this change of course, which was proven later to be correct. Running at a speed of about 13 to 14 knots an hour, the fog signal of the lightship was heard 13 minutes later than this and in the same direction from which we had already received the bell-signal. We sighted the lightship about 3.19 p.m., and passed the same about 3.25 p.m., close by, on the port side. Shortly after the first location of the submarine signal, we passed three ships which were not equipped with submarine signal apparatus, and which were still seeking to find the Weser Lightship. The certain location of the position at a distance of about 10 knots, in a heavy fog, again proves the extraordinary usefulness of the invention for the safety of navigation in all kinds of bad weather.

Cunard S.S. Co., Ltd. R.M.S. *Ivernia*,
March 19th, 1906.

Submarine Signal Co.,
247, Atlantic Ave.,
Boston, Mass.

Dear Sirs,

I wish to report that on the afternoon of March 15th, in a blinding snow-storm, when 10 nautical miles distant from Lightship No. 54, and going slow and stopping, we heard the submarine bell distinctly on the port bow and 45 minutes before the fog whistle. We made the lightship right ahead by altering the course ½ point to port. This is the best result I have had.

Yours truly,
(Signed) W. T. TURNER,
Master.

R.M.S. *Lucania*.
New York,
April 7th, 1905.

V. H. BROWN, Esq.,
Agent-General,
Cunard S.S. Co., Ltd.

Dear Sir,

I beg to report as follows :—

We had hazy weather with showers of misty rain off the Nantucket Shoals, and we would have failed to locate the light vessel but for the aid of the Submarine Signal Bell.

We heard it 8½ miles distant whilst steaming full speed, 22 knots, on the starboard bow, or side—thus—, two strokes, a short interval, then one stroke. The ship's course was altered to the northward just so that the sound of the bell could not be heard on the port side. We made the light vessel one point on the starboard bow and passed it one-third of a mile off which enabled us to obtain a good departure. The sound of the bell was musical and distinctly audible, and could not be mistaken for any other sound.

Yours faithfully,
(Signed) JAS. B. WATT,
Master.

Plant Line.—Canada, Atlantic, and Plant Steamship Company, Ltd.

S.S. *Aranmore*,
Boston, March 23rd, 1906.

Submarine Signal Co.,
247, Atlantic Ave.,
Boston, Mass.

Dear Sirs,

On March 15th, during one of the heaviest snowstorms of the winter, about 3 p.m., when seven to eight miles from Lightship No. 54, I got the submarine bell on the starboard bow, and made the lightship with ease. As I had to wait in this vicinity some time for a pilot, I ran three miles by the lightship, then turned and headed straight for it, getting my direction perfectly. My wife used the apparatus during a part of the time, and, although she had never seen it before, had no difficulty in getting the direction as well as I could myself.

Very truly yours,
(Signed) EMILIO COUILLARD,
Master.

Perhaps in some respects more remarkable still is the honour which the invention has received through the warm recognition of the United States naval authorities. Two battleships in the United States navy, the *Maine* and the *Alabama*, were equipped last summer, and the reports of their captains to the Navy Department contain the following statements :—

U.S.F.S. *Alabama*,
October 20th, 1905.

Respectfully returned to the Commander-in-chief through the Divisional Commander 1st Squadron.

The receiving apparatus of the Submarine Signal Company has been tested as opportunity was given.

Aug. 24th, 1905, Brenton Reef Lightship. Dense fog. Bell first heard on starboard bow, distant about seven miles. Headed for lightship, aided by sound of bell, and passed close aboard. Bell last heard on starboard side, distant about five miles.

Sept. 30th, 1905, Nantucket Shoals Lightship. Dense Fog. Heard bell on starboard hand between 4.54 and 5.30 p.m. The test was otherwise unsatisfactory, as neither the bearings of the lightship nor distance from it could be accurately determined ; it was estimated, however, the bell was heard at a distance of 10 miles. The fog whistle of the lightship was not heard.

The most useful test was that on Aug. 24th, 1905, when passing Brenton Reef Lightship in a dense fog. The sound of the bell was of great service in picking up the lightship.

As the value of the invention has been clearly shown I recommend that the receiver be left aboard this ship permanently.

(Signed) W. H. REEDER,
Captain U.S.N., Commanding.

U.S.S. *Maine*,
October 14, 1905.

Respectfully returned to the Commander-in-Chief, North Atlantic Fleet.

Since the installation of the sound - receiving apparatus of the Submarine Signal Co. on board this vessel, it has been tried on several occasions while passing light stations fitted with their submarine bell.

On September 30th, while making passage from Provincetown to New York, in a heavy fog, the bell was heard first at 4.55 p.m. and was lost entirely about 5.30 p.m. During this time there was thick fog and the ship was steaming 12 knots and during the interval between referred to made about seven miles. It is estimated that the ship passed abeam of the lightship a distance of four miles making the greatest distance heard a little over $5\frac{1}{3}$ miles. The fog whistle of the lightship was not heard during any of this interval or at any time while passing the lightship; the submarine bell was heard on one side only.

On this occasion I listened to the sound of the bell myself, and can say that I found it perfectly distinct, leaving no doubt whatever as to what the sound was. I consider it a very useful aid to navigation, and I think it would be well for all ships cruising on the coast to be supplied with the apparatus.

(Signed) N. E. NILES,
Captain, Commanding.

U.S. Flagship *Maine*,
Provincetown, Mass ,
September 3, 1905.

Sir,

Your letter of the 2nd instant is just received, and in reply thereto I have to say that at the time of the collision between the *Iowa* and the Brenton Reef Lightship on the 24th ultimo, the *Alabama*, which was in the vicinity, was using her submarine signals, and by them had an accurate bearing of the lightship. It being very thick the *Iowa* was on top of the lightship before she could be seen, and the collision could hardly be called such, for it little more than knocked the paint off of either ship.

At the time of the accident the *Maine* was inside the harbour and anchored, but in coming in, in the forenoon of the same day, found her submarine signals of the greatest assistance in locating and keeping clear of the lightship, and in making entrance into the harbour.

Respectfully,
(Signed) R. D. EVANS,
Rear-Admiral, U.S. Navy,
Commander-in-Chief, North Atlantic Fleet.

Mr. H. L. Higginson,
President Submarine Signal Co.,
247, Atlantic Ave.,
Boston, Mass.

As a result of these and other trials, Admiral Cowles, Chief of the Bureau of Equipment, addressed on March 5th a letter to the United States Navy, enclosing full reports of the observations made by these two battleships, portions of which I have quoted above, and concludes by saying :—

"The Bureau considers that these tests demonstrate that the Submarine Signal Co.'s apparatus is a useful aid to navigation, and will take such steps to have the receivers installed in the vessels of the Atlantic Fleet, as the status of the Bureau's appropriations will admit. It is requested that this department be furnished with the list of stations now equipped, and about to be equipped with submarine signal bells."

In other words, the apparatus has been accepted by the United States Navy Department as an aid to navigation.

It is, however, to the Lighthouse Establishment of the United States and to the Department of Marine and Fisheries of Canada that our Company is most deeply indebted. Such success, as has attended the work of the Signal Company is due in large measure to the encouragement and courteous assistance of the officers and officials of these departments

The authorities at Washington welcomed our earliest attempts; by granting access to the lightships between Boston and New York, they afforded the opportunity to install submarine bells with which to develop a practical system. Canada was the first officially to adopt it, and at the present time submarine signals are being rung in thick weather at and near the port of Halifax and at several points in the St. Lawrence River. Twenty automatic buoys are being constructed having submarine bells, and, within a few months, these are to be placed along the dangerous coast that stretches eastwardly and northerly from Halifax towards Sable Island.

Beyond the sphere in which our activities are at present applied, there lie the suggestions of many possibilities. Already on the New England coast the experiment has been repeatedly and successfully made, of equipping a

steamer with a bell submerged in a tank in her fore-peak. To such ships as are supplied with receivers, this bell heralds the approach of the vessel in all weathers. So much success has attended this development of our work that the Company is now devising a sound-producing apparatus specially adapted therefor. Along these lines lie the hope of efficient signalling between members of a naval squadron. There is, moreover, a probability amounting, in my mind, to certainty, that the movements of submarine boats can be directed, and messages exchanged between them, as well as with their head-quarters.

Above all, I must ask you to believe that by pursuing the logical development of our present endeavours, we shall see the day when not only will the protectors of our national coastlines be rendered more efficient and deadly, but the safety of those peaceful mariners who bear the treasures of commerce the world over, will be divested of its most dreaded menace, and "collision at sea" be thenceforward unknown.

DISCUSSION.

The CHAIRMAN said it might be of some interest if he briefly recounted his own experiences on the subject. He had had the opportunity of testing the invention both at Kiel, and in the English Channel. In the former case the German Admiralty, made a series of tests. At Kiel the party had a lighthouse tender, which was a large tug full of machinery for dealing with buoys, and all the appliances required for lighthouse service along the coast. It was spoon-bowed, and had very shallow draught. The trial therefore was made under very adverse conditions, but up to four or five miles from the lightship, one was able to place the source of sound within about half or quarter of a point. Though he had never tried before he experienced no difficulty. Of course a person who was deaf was not likely to use the apparatus well, and one person on board could make nothing of it, but he (Sir William) noticed that he could scarcely hear what was said to him. There were some critical people aboard, who complained that they could not hear when the bell was abaft the beam; but as the ship was then going away from the point of danger, the issue was no longer a practical one. One strange phenomenon which he noticed particularly was the following:—Many people had noticed when using the telephone that besides the sound they wanted to hear there was an undertone, and sometimes more than that, especially when people were chattering at the Exchange. Such an undertone was present in this apparatus, due to the noises of the ship, the washing of the water outside as the bows rose and fell; but the bell sound could be heard quite clearly, and could be differentiated from all other sounds. He could substantiate all that the author had said, that as the distance increased, the difference in intensity between the two sides remained; as long as the bell was heard, one could tell which side of the ship the sound came from. The ship was slowly swung, and it was wonderful to be at the instrument, and, without seeing the lightship, to tell how the bow was pointing in relation to the lightship. Two things were necessary to make the invention of practical use. One had been shown to have been accomplished, namely, the receiver apparatus in the ships. That had been devised as the result of many years of work, and out of that large expenditure of time and money had come a delightfully simple apparatus. That was true of all successful inventions; they crystallised into a simple practical form, but those who had to do with the process of crystallisation had not a pleasant time. The ship fitting was complete, the apparatus in connection with the bell, the designs of the bells, and the apparatus for manipulating the bells; but unless the bells were operated at the critical point of danger, and unless ships were fitted with the receivers, the advantage of the invention could not be realised. At the Trinity House trials there was absolute agreement on the part of all who witnessed them that the invention was practically successful, and could be depended upon to locate within a quarter of a point the source of the sound up to five or six miles. The paper now gave evidence that up to ten miles, the sound could be taken in, and its source located. The question, therefore, arose whether with the increased safety to navigation and life and property at sea which could be ensured by the adoption of such a system, it was not worth the attention of all who were concerned with shipping. Trinity House had done its part: it had practically tested the invention, and had given to the shipowners of Great Britain the opportunity of seeing that the apparatus was useful. But until the feeling in the shipping community led to the demand for the equipment of the lightships round the coast, Trinity House would have to wait. At Liverpool the business had gone further than that, and he hoped the author would include in his paper a list of the ships which had been fitted with the invention. At the present time, the Cunard Company, the White Star Company, and, he believed, the Allan Company, had been fitting their ships with it. The lightships on the other side and the ships employed in the Atlantic trade had also been equipped. The North German Lloyd Company — which had a difficult coast—and the Hamburg-American line were also making use of the invention. But until shipowners could see it was worth their while to adopt the apparatus as a means of greater safety, accompanied by greater economy in the matter of insurance, it seemed that the matter

was scarcely one for the inventors of the appliance, but for the shipowners themselves. They were the best judges of what was desirable. Fortunately, proof had already been given that the governing authorities of the leading steamship lines in the Atlantic trade answered in the affirmative, and were putting the apparatus into their vessels. It was a subject of remark that proprietors of twin-screw ships never failed to advertise that fact, so as to impress passengers with the resulting increased safety. The same was true of vessels which were well subdivided into water-tight compartments, and recently he noticed mention was made by owners that their vessels were fitted with submarine signalling apparatus. Therefore, perhaps, it would not be long before those who entrusted themselves and their cargoes for conveyance across the seas would find shipowners making more extensive use of appliances of the nature of that under discussion. To Mr. Millet himself, he thought, all interested in shipping were immensely indebted, not only for giving such information as he had, but for the personal effort which he had devoted to the subject; for Mr. Millet was not by inheritance or previous training led to take up the subject—he did so more or less accidentally, and had been more interested in publishing books in Boston than inventing. Publishing he thought was a more happy occupation than hunting about the New England seas in foggy weather. Though the author frankly acknowledged the work done by the pioneers in the matter, upon Mr. Millet himself rested the greater part of the burden of bringing the invention to its present practical working condition. His (Sir William's) own conviction from observation and personal testing was that the apparatus could be trusted, and that it was a valuable means for increasing the safety of life and property at sea.

Mr. A. R. Sennett claimed that he was the inventor of the system in reality, and handed to the Chairman the specification of a patent taken out by him in 1892, in which, he stated, most of that explained by the author was set out, including the use of the bell under the water, the use of a diaphragm, and the use of the microphone. He wished to make one or two suggestions, because it was not yet too late to make some modifications in the apparatus. In 1890 he (Mr. Sennett) had his attention directed to the matter by a note read by Mr. Stevenson, Engineer of Northern Lights, at the meeting of the British Association at Edinburgh. That gentleman said that one of the sirens off the east coast of Scotland was sounding continually in a fog, and a vessel was sent out to observe how the sound fell off. After going a quarter of a mile the sound fell off entirely and suddenly. On going several miles further the sound reappeared as strongly as at first. That revealed a point of great danger to navigation, and he felt sure of the reason. Professor Tyndall's experiments made for Trinity House, which were published in the appendix to his book on Sound, revealed what Tyndall called "acoustic clouds," which were simply strata of different temperatures of air. Before the days of electricity it was difficult for the voices of even good singers to be heard at the back of the stalls, due to the screen of uprising heated air from the gas burners at the stage front. Every stratum of air at a given temperature had its own index of refraction. In Mr. Stevenson's experiments there was such a transparent cloud, which tilted up the sound of the siren. Fortunately, the conditions in the ocean were always constant, whereas in the atmosphere the reverse obtained. Mr. Millet had given the credit of discovering that the sound of submarine signals would pass through the walls of floating structures to Prof. Blake, of America, but 100 years ago crude experiments by Colladon and Sturm on the lake of Geneva to ascertain the velocity of sound showed the same thing. They found that the best results were obtained when the mouth of the receiving trumpet was covered with a thin plate of iron. The most important point in the design was the use of a microphone. It was in the use of the microphone that he thought Mr. Millet's apparatus was capable of improvement. He (Mr. Sennett) had foreseen the necessity of eliminating the effect of all extraneous sound, and he concluded that the proper way to do that was to put the receiving instrument in isochronous unison with the transmitting instrument; the whole thing must be carefully tuned, and then the intensity of the sound received became more than quadrupled. That tuning was claimed in the second paragraph of his patent. On such tuning the whole success of wireless telegraphy had been proved to depend. What he had said was borne out by the author's statement that certain tanks gave better results than others, and acted as resonators. A siren, as against a bell, had the advantage that the lighthouse could be made to spell out its own name. He concluded by paying a high tribute to Mr. Millet's devotion and perseverance.

Mr. A. C. Brown thanked Mr. Millet for his paper, and explained and exhibited an apparatus which he himself made in 1887 with the same object. It was a submarine microphone. Behind the diaphragm was an air chamber in connection with a pipe open below to the water, so that the air-pressure within was the same as the water pressure outside. It was a very sensitive instrument. He had only tried it in rivers and canals, and it happened that it was being tested under the South-Eastern Railway arch when her late Majesty, Queen Victoria, passed over it, and he and his assistants were taken for dynamiters. The bell used was struck by hand, and also by electricity; the Morse code was signalled by it. Use might be made of the fact that sound would vary its pitch according as it pro-

ceeded from a receding or approaching ship. There might be some standard of sound on board ship, such as a tuning-fork, and when the sound synchronised with that, one could know that a ship was right, and when it did not synchronise that it was wrong.

The CHAIRMAN proposed a hearty vote of thanks to the author, and in doing so referred to his demonstration a year ago before the Institution of Naval Architects. But on the present occasion he had been able to incorporate new material.

The resolution of thanks having been carried,

Mr. MILLET, in reply, said he would still have to claim for Mr. Blake the discovery that submarine sound waves would go through a ship and could be detected on the inside of it. He was familiar with Colladon and Stürm's experiments on the Lake of Geneva, but he had never been able to find any statement of the fact that the bell sounds were heard inside the boat used; a trumpet-shaped apparatus with a small diaphragm was lowered over the side of the boat. Mr. Blake's discovery was made in 1883. He (the author) had spent much time and money in tuning diaphragms, but it was impossible to make two bells of exactly the same dimensions emit the same sound in the water, whatever care was taken to make them alike. Such bells at 25 and 30 feet depth would give diffeient notes, and in order to make the receiving apparatus synchronous it would be necessary to change it. If a sound could be detected five or six miles off that appeared to be good enough. On the *Lucania*, going at 22 knots, and the *Kaiser Wilhelm II.*, at 24 knots, with a tide of four knots or more, the apparatus worked satisfactorily. He distrusted anything which required delicate tuning. Sirens under water had been tried, but the bell was greatly superior because of the impact produced by the hammer. In the absence of impact it was sometimes difficult to detect the direction of the sound. Moreover, the bell note was more musical and carried better, and could be more easily distinguished from other sounds than could the siren.

STATE INEBRIATE REFORMATORIES.

Attached to Sir E. Ruggles-Brise's report on the proceedings of the International Parliamentary Congress, will be found a memorandum on State Inebriate Reformatories, created and developed under the Act of 1898, for the detention of habitual drunkards. That Act provides power to commit two classes of inebriates to detention for the purposes of control and reformation :—(1) Persons convicted of offences caused or contributed to by drink—offences which would otherwise be punishable by imprisonment or penal servitude, and (2) habitual inebriates who have been convicted four times within one year of drunkenness, or of certain other specified offences of which drunkenness is a part. During the first two years of the working of the Act, no State reformatory was in existence, but during this time experience was gained enabling the authorities to decide what should be the exact relation of the State reformatory to the private or certified reformatory. It was found that these latter were quite capable of dealing satisfactorily with all inmates except those of violent and uncontrollable character. These latter amount to about 10 per cent. of the whole, and require a more severe system of control and detention than it is possible for the private reformatory to supply. It was decided, therefore, to confine the chief use of the State institutions to the reception and treatment of persons who had proved uncontrollable in the ordinary reformatories.

Although State reformatories are conducted on prison or penal lines so far as is necessary to insure safe custody, strict asylum principles are adopted in all matters relating to the treatment of inmates. The medical aspect of the case controls all questions of restraint and punishment. The value of the State reformatory will therefore be shown by the number of cases rendered amenable, and returned to private institutions, the hopeless cases only being retained. The value of the State reformatory will not consist in the production of actual results, but its existence will permit of certified institutions carrying on the work of reformation otherwise impossible. It will also ensure the retention, to the end of their sentence, of persons who are dangerous at large, a disgrace to the streets, and an important source of contamination to others.

As to discipline, the great difficulty is to discriminate between insubordination due to mental weakness, and that which results from pure viciousness. A large majority of the inmates cannot be classified accurately, either as insane on the one hand, or as merely vicious and wanting in self-control on the other. They are on the borderland of these two states. Generally speaking, the experience hitherto obtained, says Sir E. Ruggles-Brise, would seem to show that the cases received into the State institutions can be classified as follows:—Insane, 10 per cent.; sane (but vicious), 20 per cent.; on the borderland between the two, 70 per cent. As regards State inebriate reformatories, little result can ever be shown in the direction of actual reformation, because—(1) Every inmate sent from certified to State reformatories is sent because of refractory, violent, or vile character, after all measures that kindness and consideration can suggest have been tiied, and failed, and (2) because any inmate who gives evidence of possible good results in State reformatories by becoming quiet and amenable is returned to a certified reformatory, and is consequently lost sight of so far

as the records of State reformatories are concerned. But, says Sir E. Ruggles-Brise, "the influence of State institutions is nevertheless one of inestimable reformatory value, for it exists to enable other institutions to do their work in a proper manner, unhampered by the refractory element, and to apply stricter discipline to those refractory persons, in the hope that they may be made sufficiently amenable for subsequent treatment under conditions of lighter restriction in certified institutions."

THE SUGAR-BEET INDUSTRY IN GERMANY.

The importance of sugar-beet culture in Germany does not rest wholly upon the production of the beets which furnish the raw material for the production of sugar, but in no small measure also upon the production of large quantities of by-products, which are mainly used as food for cattle. It has been said that the profit derived from the waste products of the factory and those parts of the beet left in the field are almost as great as the profit from the manufacture of sugar. The leaves and tops of the beets, as they are garnered, are a very useful waste product; but very frequently they are given to the men who pull the beets, dress them, and pile them up, or pit and silo them in the field, in lieu of wages. Of still greater importance is the residuum pulp left after the sugar has been extracted from the beets. It amounts to about 50 per cent. of the tonnage of beets sliced in a factory, and makes a good food for all kinds of stock, but it requires considerable care and judgment in administering it properly. It can be stored in silos and left for months for feeding purposes; but it is more generally evaporated, and when thus dried becomes not only less perishable, but is made more useful and marketable. However, as the process of evaporating pulp in factories specially built for that purpose, with costly machinery, is a very expensive one, dried pulp has not yet become very popular in Germany. It is commonly estimated that about 17 cwt. of fresh pulp will make about 2 cwt. of dried pulp, the market value of which during last year was from 4s. 6d. to 5s. 6d. per cwt. The American Consul at Bremen states that it is the rule at German sugar factories to deliver a part of their fresh pulp to the farmers supplying the beets in the ratio of about 40 to 50 per cent.—that is to say, if a farmer hauls one ton of beets to the factory, he takes home with him about half a ton of pulp without any extra charge. It must be added, however, that the farmers in such cases are also shareholders in the factory. The balance of the pulp is either used as food for the stock belonging to the factory or sold in the open market. The price paid varies from 3d. to 10d. per cwt. The molasses residue finally left from beet-sugar factories is of a very low grade, and may then be turned to many uses in different industrial enterprises, such as the making of potash, blacking, vinegar, yeast, drystuffs, &c., but by far the greater part of it is utilised in Germany in the manufacture of alcohol, and last, though not least, also as a food for cattle. The molasses are not used as cattle food entirely by themselves, but always with the admixture of pulp or some other fodder to counteract the evil effects that they otherwise would have on cattle. Very often they are mixed with turf taken from the upper strata of peat moors, which in itself has no value as a food whatever, but when so mixed it is claimed that it is a cheap and wholesome substitute for the best approved food for animals. The amount of molasses produced during the past two years was 392,019 tons in 1903-4 and 371,093 tons in 1904-5. In the German sugar-beet industry there is absolutely no waste; even the settlings of lime and of the dirt and soil dropped from the beets while they are being washed are either given to the farmers or sold to them, and both serve as excellent fertilisers.

THE GERMAN AUTOMOBILE TRADE.

From a recent report of the American Vice-Consul at Mannheim, it would appear that the manufacturers of automobiles in Germany are enjoying their full share of the highly prosperous condition of the German iron and machinery industries. He states that the official estimate of the value of German motor production in 1905 is £2,000,000, and adds that the export of automobiles from Germany, principally to the United Kingdom and France, increased from 546 tons in 1902 to 2,300 tons in 1905. The inquiry for automobiles has of late been so enormous that one of the leading firms in the business made the statement that twice the present possible production in Germany would not supply the demand, especially for heavy vehicles. This condition of affairs has necessitated considerable importations of machines, principally from France. Enthusiasts hold out the prospect of a general automobilisation of omnibuses and all public vehicles within the next few years. The benzine motor still predominates, and will probably do so for some time yet, as the expectations placed in the electric motor have not been realised. England is Germany's best customer for automobiles, and orders for 300 to 400 machines at a time are sometimes received, principally for omnibuses and heavy carriages. The execution of orders is frequently impeded and delayed by the scarcity of raw materials. The only dark cloud on the otherwise bright horizon of the German automobilist, is the Bill at present before the German Parliament imposing a special tax on automobiles, and heavy damages to be paid in case of injury to the public.

HOME INDUSTRIES.

Adulteration in the Leather Trade.—At one time American sole leather enjoyed, and deservedly, a reputation for wear and water-resisting qualities, owing to the method of tanning with hemlock bark, but nowadays some American tannages are better known for the extent to which adulteration is employed. Recently the Tanners' Federation decided to go into this question of adulteration, with the object of proving to the boot manufacturer the very poor wearing and water-resisting qualities of the lower-priced American sole leather. The Federation obtained samples, representing the average imports of sole leather from the United States, with the object of ascertaining the extent to which American sole leather coming to this country is adulterated. Eighteen samples were collected, embracing the well known and largely used tannages. These were all cut from the same part of the hide, and, as far as possible, from the same weight of side. The results of the analysis show that the average amount of weighting matter was as follows:—Epsom salts, 2·03 per cent. and crude glucose, 7·84 per cent.; total weighting matters, 10·16 per cent. Allowance was made by the analysists "for the presence of natural sugary matters which, to a small extent, is found in all tanning materials. It is very exceptional that the proportion exceeds the 2 per cent. allowed. . . . It is probably safe to regard any leather showing under 1 per cent. of mineral ash as free from mineral adulteration. With a somewhat higher ash, and distinct adulteration with glucose, the Epsom salts may be considered as added for weighting purposes." Water penetration tests were also carried out. Each of six samples was subjected to a column of water twelve inches high and two inches in diameter. The time required for the water to penetrate completely through the leather was as low as forty minutes in one case, and as high as fifty-five hours in another. A similar test was made of certain representative English tannages, tanned by various methods, and for varying periods, which conclusively demonstrated the inferior water-resisting qualities of the adulterated leathers. Excluding one of the American samples, an exceptionally bad one, containing 30 per cent. of adulterants, the 17 remaining samples still give 7 per cent. of added glucose and 2 per cent. of Epsom salts. The analysis showed that, compared with certain English tannages, the samples were not very heavy weighing, but then they are usually made under-tanned, and the shortage of tanning matter is made up by the added adulterants which, by non-combination, are washed out as soon as the leather comes into contact with water, leaving the soles soft and porous. The Tanners' Federation do not suggest that all English sole leather is free from adulterants, but, so far as can be ascertained, it is safe to state that, generally speaking, English sole leather tanners do not weight their leather with foreign matters.

Hydro-Electric Scheme. — India offers an expanding outlet for electrical machinery and plant, its numerous flourishing industries, and municipal, military, and Government establishments combining to create an important demand, much of which is catered for by Continental manufacturers. Recently a very elaborate and complete electric installation was put up by the Secretary of State for the Imperial Mint at Calcutta, and a contract was lately given out for a complete electric plant, including motors and transformers, for the carriage and wagon works at Lillwah. Tenders were also recently invited for the lighting of the military cantonments at Lucknow. A scheme of great magnitude, and if realised, of far-reaching industrial importance, has lately been launched for the construction of a hydro-electric power installation in Kashmir, by harnessing Whelan River. The available water-power is said to be practically unlimited, and is to be utilised to supply the current for an electric railway 200 miles in length, to connect Abbtabad with Sringagar; to propel a large fleet of powerful electric dredgers, which will be employed in safeguarding Kashmir against disastrous floods, and in reclaiming valuable rice-producing tracts of lands from the marshes; to supply the motive power for numerous proposed factories, thereby serving to convert Kashmir into the Lancashire of India; to import new energy into the great silk industries of the province; to supply power for local tramways and light railways, arsenals, workshops, foundries and mines, and provide the current and electric lighting; and for driving punkahs in the big railway cantonments of northern India. The price of electric power, it is expected, will be less than half that of steam power. The initial supply will be equivalent to 80,000 horse-power. It is a big scheme and a company with a capital of £2,000,000 has just been formed to carry it out.

Bridge Building, &c., for India.—Manufacturers of bridge work, railway permanent way material, and railway stock may look for a considerable volume of indents from India in the near future as the result of the Provincial Government's railway extension and improvement programmes and road construction schemes. Among the projected improvements is the contemplated renewing of all the bridges between Raneegunge and Luck Preserai, and on the Giudh branch, which is to be carried out at a cost of Rs. 1,72,000. These bridges will all be of the girder type. The rebuilding of the Chandmaree bridge, off the Howrah new station, is also contemplated at a cost of Rs. 1,29,000. Of railway extensions the survey has been ordered of a line fifty-eight miles long from Azangarh to Gosaingarj on the Baroda and North-Western Railway, affording a link with the Oudh and Rohilkund Railway. The survey has likewise been sanctioned of a new line from Rangya to Tezpur, seventy-eight miles long, on the Eastern Bengal-Sindh Railway. The Railway Board have also accorded their sanction to the fifty-nine mile extension from Rosa to Setapur. The Maghalserai-Gya extension on the East Indian Railway is another

undertaking which is to be carried out at a cost of Rs. 1,51,97,000. Among contracts recently placed with home firms is one for forty swan bridges of about 60 feet span for the East Indian Railway. This follows an order for 170 bridges of 40 feet span each for the North-Western Railway of India. The Home Board of the East Indian Railway have also invited tenders recently for the steel work for the Jumna Bridge, Allahabad, the main span being 160 feet, and the land span 40 feet. An indent has also been forwarded by the Government of Madras to the Director-General of Stores for rolled steam beams and Horbury's patent arched steel flooring for the iron girder bridge over the Bhimavaram lock in the Godavari Western Division. The Bengal and North-Western Railway have furthermore invited tenders lately in England for 112 bridge spans of 10 feet each, and the East India Railway for deck bridges of 60 feet span in the clear. The last named railway also intend to expend a lakh of rupees on the provision of 595 cowcatchers for its engine rolling stock. Additional rolling stock is to be provided for the Eastern Bengal-Sindh Railway at a cost of Rs. 8,67,000, and including 150 bogie iron-covered goods wagons, metre guage. These various plans and contracts provide points of much interest to engineering circles at home.

Shipbuilding in 1906.—Whilst the new contracts for ships during the present year have been few compared with those for the corresponding months of 1904-5, the shipbuilding yards were never more active. In Scotland, the production for the first quarter of the year was no less than 137,640 tons, the record being progressive, 36,348 tons in January, 40,988 in February, and 60,304 tons in March. This is the largest tonnage ever put into the water from Scotch shipyards in the first three months of any one year in the history of the industry, the output of the past quarter exceeding that of the corresponding quarter—a very busy one—of 1905, by 23,000 tons. It is to be noted that only about 10,000 tons of the vessels produced in Scotland during last quarter were for foreign registers, so that the three months launches add some 127,000 tons to the British register. Moreover, the North of England builders have been building in much the same proportions. According to Lloyd's returns—which, by the way, do not include unclassed vessels of over 100 tons—there were at the end of March, 1,401,881 gross tons of merchant vessels under construction in the United Kingdom, and this does not include war ships. It compares with 1,251,343 tons under construction at March 31, 1905. Now orders, however, are not keeping pace with launchings. Thus, in March, 60,304 tons were launched in Scotland, and only 6,000 tons of new contracts booked. But it is believed that more contracts have been arranged than have been officially reported, and that still more are merely being held in suspense until the labour questions have been finally disposed of. The price of material, too, has had a good deal to do with retarding new business. There are no serious labour troubles likely to affect the industry in England just now, but in Scotland the very troublesome question of the method of payment of wages has again become acute. At present the men are paid fortnightly, and they are insisting on being paid weekly. It might be thought this is a very small matter out of which it would be impossible for serious labour troubles to arise. Unfortunately that is far from the case. Put plainly, the employers object to weekly payments because the men are unfit or disinclined for work for a couple of days after getting their wages. Naturally the employers want to avoid the loss of time which, unhappily, follows every pay day in the Scotch yards among certain sections of the men. But they are insisting upon the change, and the employers have now to give their definite reply. Should it be in the negative, the whole of the shipyards and engine shops on the Clyde may go on strike, for the question affects not only shipwrights and boiler makers, but also engineers, carpenters, joiners, iron moulders, plumbers, painters, cabinet-makers, and other miscellaneous craftsmen.

The Cotton Trades Disputes.—The Manchester Conference between representatives of the Cotton Operative Spinners and the Employers' Federation warrants the hope that the conciliation scheme, for the automatic regulation of wages from which so much is expected will be carried through, and serious labour trouble avoided. The spinners accepted the advance of 5 per cent. from the third pay-day in May, and gave assurances of their desire to secure the adoption of the scheme of conciliation in wages' disputes. The Federation has now resumed negotiations with the card-room workers, who are equally concerned with the spinners, and if a similar agreement is approved by such representatives the settlement will be complete. It was understood, when the advance of 5 per cent. was offered and accepted, that "it is recognised on both sides that an earnest endeavour be made to complete the conciliation scheme," and that, if the scheme falls through, and there is a return of bad trade, a reduction of wages shall be accepted, provided it is not asked for earlier than a twelvemonth from date. It may be hoped, however, having regard to the good spirit shown by employers and employed, that the conciliation scheme will go through.

Rent Profits.—The allegation that some landlord of large blocks of residential buildings enter into arrangements with electrical supply companies under which the tenant pays, say, $5\frac{1}{2}$d. per unit to the landlord, whilst the landlord himself pays only 3d. per unit, deserves, as it may be hoped it will receive, investigation. If electricity were supplied to flats at something like 40 per cent. below the present charge it would be much more used for heating, lighting, and power purposes, than it is at present. After all, it is the tenant's wishes that

regulate matters of this kind. If there is a general desire in this class of tenancy for the electric light the landlord must supply it, and it may be expected to pay the companies better to charge the lower rate, since the demand for their product would be greatly increased.

CORRESPONDENCE.

GROWTH OF THE SUGAR INDUSTRY IN MEXICO.

In reference to the note on above subject appearing on page 636 of the *Journal*, it may be interesting to show that the estimates of production have actually been exceeded.

The Government official returns up to June, 1905, reached me last week, and I beg to give below the figures showing the tonnage of sugar-cane and sugar exported from Mexico for each of the three years 1902-3, 1903-4, and 1904-5, together with the proportion taken by this country:—

SUGAR-CANE.

	Kilograms Exported.		Tons.
1902-3	113,846	=	112
1903-4	164,360	=	162
1904-5	83,754	=	83

SUGAR.

	Kilograms Exported.		Tons.	Taken by Great Britain. Kilograms.		Tons.
1902-3	8,003,102	=	7,885	6,649,739	=	6,551
1903-4	16,313,211	=	16,072	13,889,747	=	13,684
1904-5	38,701,085	=	38,129	27,830,691	=	27,419

In the list of counties mentioned in the note there were one or two clerical errors, but these were not of much moment as the names would probably be recognised by persons interested:—Jalcingo should read Jalacingo; Minatillan, Minatitlan; Orikaba, Orizaba.

S. CHAPMAN.

225-8, Gresham-house, Old Broad-street, London, E.C.
April 30th, 1906.

OBITUARY.

SIR THOMAS ACQUIN MARTIN.—Sir Acquin Martin, a member of the Society of Arts since 1896, died on Sunday, 29th ult., at Binstead-house, Ryde. He was the son of Patrick William Martin, merchant, and born at Four Oaks, Sutton Coldfield, in 1850. He was educated at the Oratory, Edgbaston, and continued his education as a civil engineer. He was head of the firm of Messrs. Martin and Co., of Calcutta, and Messrs. T. A. Martin and Co., of Laurence Pountney-hill, London. He was Agent-General to the Government of Afghanistan, and was knighted in 1895, on the occasion of the Shahzadah's visit to England.

GENERAL NOTES.

ELECTRICAL DEVICES EXHIBITION.—The American Consul at Lyons reports that a general exhibition of all electrical devices that can be applied to domestic uses, is to be held in that city during the months of July and August next. It will be held under the auspices of the Agricultural and Scientific Association of Lyons, and no motor will be accepted for exhibition which is over one horse-power. The object of the exhibition is to bring cheap electrical appliances nearer to the people, in order that the great mass may derive some benefit from them—motors that may be used on embroidery, sewing and knitting machines, ventilators, vacuum carpet and rug cleaners, horse cleaning machines, floor polishers, carts, turning spits for cooking, &c. Motors for weaving are excluded. They have been in use in and around Lyons for the last three years, and it is deemed advisable to have an exhibition at an early date expressly for such motors.

MINERALS OF KOREA.—The mineral output of Korea is principally gold, recovered both by placer and quartz mining, with over one hundred and twenty workings, and an annual production of about £450,000. Placer gold represents 66 per cent. of the total. There are silver deposits, but only experimental workings have been made. Copper is found mostly in the northern and southern portions of the peninsula. The Kap-san mine is producing some 270,000 pounds of refined copper per annum. Iron is found in several provinces, but the expense of mining and smelting have retarded its exploitation. There are some coal deposits, that at Pyeng-Yang consisting of smokeless coal, and the others of rather inferior bituminous coal. Excellent crystal is found in North Kyeng Seng, and is a famous product of Korea. Talc of excellent quality is found at Pyeng-hai and Yee Chun, but this has not been worked.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MAY 9.—"Bridge Building by means of Caissons, including remarks upon Compressed Air Illness." By PROFESSOR THOMAS OLIVER, M.D., LL.D.

MAY 16.—"The Development of Watermarking in Hand-made and Machine-made Papers." By CLAYTON BEADLE. SIR FRANCIS HAYDN GREEN, BART., will preside.

MAY 23.—"The General Supply of Electricity for Power and other Purposes." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E. SIR WILLIAM H. PREECE, K.C.B., F.R.S., in the chair.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.B.M.'s Consul-General and Agent to the Government of India at Khorasan, "The Parsis of Persia."

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

MAY 8.—"Damascening and the Inlaying and Ornamenting of Metallic Surfaces." By SHERARD COWPER-COLES.

MAY 29.—"Glass Cutting." By HARRY POWELL.

*** This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

ALFRED MASKELL, "Ivory in Commerce and the Arts." Three Lectures.

LECTURE III.—MAY 7.—Applications and uses of ivory in the industrial and decorative arts—Religious statuettes and figures of mediæval times—Pastoral staves and other liturgical accessories—Caskets, marriage coffers, mirror cases, combs, and other domestic articles—Arms and hunting horns—Tankards—Tobacco graters—Portrait medallions—Chessmen and draughtsmen and boards—Ivory sculpture in India, China, Japan—Musical instruments—Furniture and inlaid work—The working of ivory: the lathe and turnery—Forgeries of works of art—Ivory sculpture at the present day in France, Belgium, and England—The position of ivory sculpture, with a plea for its encouragement. (The lecture will be illustrated by examples and by numerous slides.)

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.
May 14, 21, 28.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. Maskell, "Ivory in Commerce and in the Arts." (Lecture III.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Dr. David Sommerville, "The Chemistry and Bacteriology of Potable Waters."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. John Goode and Dr. F. Mollwo Perkin, "Some Notes on the Gutzeit Test for Arsenic." 2. Messrs. W. C. Reynolds and R. Sutcliffe, "The Separation of Brucine and Strychnine. Influence of Nitrous Acid in Oxidation by Nitric Acid." 3. Messrs. W. P. Dreaper and A. Wilson, "Absorption of Gallic Acid by Organic Colloids."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Col. G. E. Smith, "From Victoria Nyanza to Kilimanjaro."

British Architects, 9, Conduit-street, W., 8 p.m. Annual Meeting.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. A. B. Grimaldi, "The Zodiac: its History and Biblical References."

Society for the Encouragement of Fine Arts, 6½ Suffolk-street, Pall-mall, S.W., 8 p.m. Rev. H. G. Rosedale, "With the British Association in South Africa."

TUESDAY, MAY 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Sherard Cowper-Coles, "Damascening and the Inlaying and Ornamenting of Metallic Surfaces."

Asiatic, 22, Albemarle-street, W., 3 p.m. Annual Meeting.

Childhood Society, 7, St. James's-square, S.W., 3 p.m. Annual Meeting. Address by Sir Edward Brabrook.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. Stirling, "Glands and their Product s.' (Lecture I.)

Hellenic, Society of Antiquaries, Burlington-house, W., 5 p.m.

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. A. Sawtell, "India under British Rule."

WEDNESDAY, MAY 9...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Prof. Thomas Oliver, "Bridge Building by means of Caissons, including remarks upon Compressed Air Illness."

Biblical Archæology, 37, Great Russell-street, W.C. 4½ p.m.

Geological, Burlington-house, W., 8 p.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p m.

African Society, Imperial Institute, South Kensington, 8 p.m. Mr. J. Cathcart Wason, "The Importance of West Africa."

THURSDAY, MAY 10...Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Discussion on Mr. L. Andrew's paper, "Long Flame Arc Lamps."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

United Service Institution, Whitehall, S.W., 3 p m. Rear-Admiral Sir Charles Campbell, "The Organisation and Fighting of a Modern Battleship."

Royal Institution, Albermarle-street, W., 5 p.m. Rev. J. P. Mahaffy, "The Expansion of Old Greek Literature by Recent Discoveries."

Iron and Steel Institute, 25, Great George-street, S.W., 10½ a.m. Annual Meeting. Reading of Papers and Discussion.

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, MAY 11...Royal Institution, Albemarle-street, W., 9 p.m. Prof. J. H. Poynting, "Some Astronomical Consequences of the Pressure of Light."

Iron and Steel Institution, 25, Great George-street, S.W., 10½ a.m. Annual Meeting (continued).

Astronomical, Burlington-house, 5 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W.

SATURDAY, MAY 12...Royal Institution, Albermarle-street, W., 3 p.m. Prof. Charles Waldstein, "English Furniture in the Eighteenth Century.' (Lecture III.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 14, 8 p.m. (Cantor Lecture.) GEORGE W. EVE, "Heraldry, in Relation to the Applied Arts." (Lecture I.)

WEDNESDAY, MAY 16, 8 p.m. (Ordinary Meeting.) CLAYTON BEADLE, "The Development of Watermaking in Hand-made and Machine-made Papers."

Further details of the Society's meetings will be found at the end of this number.

APPLIED ART SECTION.

TUESDAY, MAY 8th; ALAN S. COLE, C.B., in the chair. The paper read was, "Damascening and the Inlaying and Ornamenting of Metallic Surfaces," by SHERARD COWPER-COLES.

The paper and report of the discussion will be published in a future number of the *Journal.*

CANTOR LECTURES.

On Monday evening, 7th inst., Mr. ALFRED MASKELL delivered the third and last lecture of his course on "Ivory in Commerce and in the Arts."

On the motion of the CHAIRMAN (Mr. G. W. Holtzapffel) a vote of thanks was passed to the lecturer for his course of lectures.

MEETING ON GLASS CUTTING.

The meeting of the Section on Tuesday evening, 29th inst., when Mr. HARRY POWELL will read a paper on "Glass Cutting," will be held at the Whitefriars Glass Works, Tudor-street, E.C., by the kind permission of Messrs. James Powell and Sons.

The accommodation is strictly limited, and 100 tickets only will be issued. These tickets will be issued in order of application to members until the number is exhausted. Each member is entitled to apply for one ticket, which will be transferable.

No one can be admitted without a ticket.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday, April 26, 1906; SIR STEUART COLVIN BAYLEY, K.C.I.E., C.I.E., in the chair.

The CHAIRMAN said he had to apologise for the absence of Sir William Lee-Warner, who was unable to take the chair owing to the death of a relative. He (Sir Steuart Bayley) had had the advantage of seeing the paper, and had noticed one grave omission: Sir Henry McMahon had said nothing about himself or his mission and its troubles. If the author had unbosomed himself upon that subject, he would have had to tell of long-continued difficulties of all sorts, difficulties of climate, both heat and cold, of dreadful dust storms and drought—(the audience would recollect the tragic death of one of Sir Henry's surveyors under those conditions)—of local opposition, for there were those who did not wish his peaceful mission to succeed, of attempts to get him out of the country by stopping supplies, by boycotting him, by trying to frighten him, by riots,

and by complaining to the Central Government of his escort as an invading army. Of all those troubles and sufferings the author had not said one word in his paper, but they were known to him (the Chairman) through his having had the pleasure and satisfaction when he was in office of seeing Sir Henry McMahon's diaries. All the efforts that were made by the anti-English party and their instigators to endeavour to make him leave the country were met with unexampled patience, and with a good temper, tact and ability that left his opponents absolutely powerless in the face of them.

The paper read was—

SEISTAN: PAST AND PRESENT.

By Sir Arthur Henry McMahon, K.C.I.E., C.S.I.

When I was asked some time ago to read a paper before this Society on Seistan, I felt considerable diffidence in consenting to do so, because I had already promised to read a paper on the same country before the Royal Geographical Society. I soon found, however, on setting to work that the physical geographical aspect of Seistan in itself afforded more than ample material for one whole paper, and that various other interesting aspects of that country were crowded out.

I propose to-day to deal with some of those which relate to the human element in Seistan, and to give you some idea of the Seistan of the past as shown by traces of human handiwork in the shape of old ruins and antiquities, and to describe to you in contrast thereto the Seistan of the present day.

I shall consider my labours well rewarded if I am able to give you some slight knowledge of a very little known country, and prove to you how deserving it is of far greater notice and study than has hitherto been given to it in England.

A glance at the map will show that Seistan is situated half in Persia and half in Afghanistan, and is about half-way between the Russian border in Turkestan and the Persian Gulf. It is a low-lying basin, over 7,000 square miles in area, from which the ground slopes upwards on all sides to the watersheds of the distant and high mountain ranges which surround it. Into this basin all the drainage of the surrounding country falls. The Helmand, Khash, Farrah Rud, and Harut Rud rivers discharge themselves into it; of these the Helmand is by far the largest. It is some 600 miles in length, has a big volume of water, and is the only large river in Southern Asia between the Indus and Tigris. The irrigated portion of Seistan is a fertile oasis, almost entirely surrounded by vast, waterless deserts.

More detailed examination of Seistan shows that it is composed of a series of deltas. Each of its rivers has its own delta. Some have more than one delta, and we find that the Helmand has three large deltas. The one at present used by the river is the present inhabited portion of Seistan. It is a large tract of great fertility.

From the traces of old river beds everywhere visible we see that the Helmand has at various periods discharged itself into its other deltas—*i.e.*, that on the south, which we may call the Tarakun and Ramrod tract, and that on the east, which we know as the Sar o Tar tract. Not once but many times in past ages has the river swung from one delta to another.

The Hamun or lake into which the Helmand and other rivers discharge themselves is now situated round the north and west of present Seistan. As the Helmand swung from side to side, the Hamun has done so too. Tracts which were once wide lakes are now waterless deserts, and some which were once dry, are now lakes. Thus we find the ruins of an old city called Sabari Shah under the waters of the present Hamun.

With the rivers has come, and still comes, silt, which gradually covers the surface of the deltas in use, and buries the old surface and its old canals and old ruins. These now and again become exposed by deep wind scours or by the rivers cutting new deep channels for themselves. Everywhere in Seistan, except on the higher gravel-covered terraces, we find ruins. No country in the world contains so many. Everywhere one looks are ruins stretching away as far as the eye can see. The number, magnitude, and nature of these ruins testify to a time when Seistan was far more populous, prosperous, and civilised than it is to-day.

For some explanation of this phenomenon we naturally turn to the past history of the country. Very little study suffices to show us that the little known and almost forgotten Seistan of to-day played a prominent part in the history of the past, and that it was, moreover, the birthplace of romance and of the history, both legendary and real, of ancient Persia.

It was the home of the famous Sam and Zal and their descendant, the great hero Rustam,

whose prodigious feats of valour form the subject matter of some of the most ancient of Eastern literature. Rustam and his deeds bring us out of the mists of myth and legend on to the threshold of the real history of Persia. To his victories over men and dragons, monsters and demons, and over the armies of the North and West, and even distant China, is ascribed the establishment of the power of the ancient Achæmenian dynasty, whose long line of kings, Cyrus, Darius, and others, have shaped the destinies of the world.

Kai or Kaikobad, the founder of the Kayani or Achæmenian dynasty, is said to have had his birthplace and home in Seistan. His name lives there still, for not only is it connected with various ruined sites, but the Kayanis, the old ruling family of Seistan, which is still extant, claim descent direct from Kai.

In later ages the great Alexander steps across the Seistan stage. He rested his army for some months in that country on his way to India, and a portion of his army marched through it on its return journey. Alexander's historians speak highly of the prosperity and civilisation of Seistan, which they call Drangiana or Zarangiana. Alexander himself was so pleased with the hospitality afforded him in Seistan that he is said not only to have confirmed its ancient privileges, but to have extended its territory.

The country appears to have formed part of the territories handed over by Alexander's successors to Chandra Gupta, the great King of India, and it formed part of the vast dominions of his grandson, Asoka.

Next we find the Scythians appearing on the scene. They invaded the country, and, although they only held it for a comparatively short time—only one or two centuries—they have left a lasting memorial of their stay in the present name of the country, for Seistan is merely a later form of Sejistan, and that of Sakoestan, *i.e.*, the land of the Sakoe or Scythians. The Scythians were driven out somewhere about A.D. 275 by the Sassanian King Varahran II.

An older and more universal name for Seistan, the name by which it was known to early historians, and the name so common on Seistan coins, is Nimroz. Its origin is attributed by some to a supposed connection to Nimrod; but the late Sir Henry Rawlinson, who devoted considerable attention to the archæology of Seistan, supports the view that Nimroz, which means "mid-day," is the Persian equivalent to Meridies and means the south — *i.e.*, country of the south. It is not south of the Persia of to-day, but it was south of the Iran of the earlier days in which this name originated.

After the expulsion of the Scythians, Seistan seems to have enjoyed a long period of prosperity under Sassanian rule, and the Zoroastrian religion, as marked by the many ruins still visible of ancient fire temples and towers of silence, flourished in the land.

Next on the scene, as far as we know, came the Arabs, who conquered Seistan in the 37th year of the Hegira (A.D. 659), and held it for many centuries. Many of the ruins so abundant in Seistan belong to this Arab period.

In the ninth century, one Yakub Bin Lais, a coppersmith of Seistan, founded the Sufarian dynasty, which ruled from Cabul to Shiraz. The celebrated old historian, El Istakri, who visited Seistan during that period, speaks highly of its prosperity and wealth, and gives a long account of Zaranj, its capital.

Prosperity and wealth, which seem to have been the good fortune of Seistan for so many centuries, now began to bring about its own punishment, for from the tenth century onwards the history of the country is nothing but a succession of devastating inroads by devouring hordes. Mahmud of Ghazni, Jenghiz Khan and Timurlang each visited it in turn and left it a more and more impoverished and stricken country.

The bravery of the people, which all old writers have praised, only increased their misfortunes. They succeeded in repulsing Timur on his first inroad, and he himself received a wound, from which he derives his name of Timurlang, or Timur the lame. He vowed he would take a sanguinary revenge, and he returned twenty years after (about 1400 A.D.) and devastated the country. He took the capital, Zaranj, after a valiant defence, and massacred all its inhabitants. The bones and skulls which fill the ruins of old Zaranj, now called Zahidan, testify to this day to his savage butchery. To Timurlang is attributed a still greater act of vandalism in the destruction of the dam across the Helmand on which the irrigation of the country depended. It threw the land out of cultivation, and it has never yet recovered from the desolation then brought about.

Great efforts have been made by the local Kayani dynasty, who claim descent from Kaikobad, the founder of the Achæmenian dynasty who ruled the country for many

centuries, to restore the prosperity of the country, but with but poor success. The Kayani family themselves through faction and discord have, like their country, gradually declined in prosperity and importance. Only a few members of this old family now exist, and they are in very impoverished circumstances.

In the eighteenth century the history of Seistan takes a new turn. Seistan, as part of the dominions of the Persian king Nadir Shah, came at his death in 1747 into the possession of his successor Ahmad Shah, and thus for the first time came under Afghan rule. This rule lasted over a century, but was never more than nominal. The Persians, taking advantage of this and of the rivalry of local Seistan factions, gradually increased their influence in the country, and finally, in 1866, occupied a portion of it with Persian troops.

The disputes which arose from this proceeding between Persia and Afghanistan led to a reference to the British Government for arbitration. General Sir Frederic Goldsmid, who was sent as arbitrator to Seistan in 1872, laid down a boundary line on paper between Persia and Afghanistan in Seistan.

This settlement merely perpetuated what the course of local events had already brought about in the division of Seistan between Persia and Afghanistan, Seistan, after a long and chequered history, ceased to possess any individual existence as an undivided whole.

Sir Frederic Goldsmid, in laying down his boundary, defined the main channel of the Helmand as forming a portion of that boundary. In 1896 the Helmand left its old and adopted a new main channel. This caused fresh disputes about the boundary, and the British Government were again asked to arbitrate. Arbitration has resulted in the boundary line awarded by me as arbitrator being accepted by both countries; and that line has now been demarcated throughout its entire length of 200 miles by massive boundary pillars, which should obviate further disputes of a boundary nature.

So much for the history of Seistan in the past. I trust that I have said enough to show what an interesting history it is. Much has been written of various periods of that history by historians of all ages; but many pages of it are still blank, and there is much left to discover, study, and record.

Doubtless a careful comprehensive study of the old ruins which everywhere abound so plentifully in Seistan will add to our knowledge of past history. We have done much during the long stay of two and a half years of the Arbitration Mission in Seistan in visiting and examining these ruins, many of which had never previously been seen by Europeans. We have made a large collection of the old pottery, china and glass, and the old seals and coins we found in those ruins. We have made plans of many old ruins and photographs of a very great number. We have been able to definitely decide the identity of some ruins with the places named in history, and to collect information which may assist the identification of others. Much of our material is not yet worked out, but I hope that an archæological report on Seistan, which is being prepared by Mr. G. P. Tate, the Survey Officer of our Mission, will embody all the information we have collected.

The ruins are of all kinds and in all stages of decay, from shapeless mounds of earth to lofty structures that look almost as new as if they had been built yesterday. They all possess one characteristic in common. All have their lower courses made of baked brick and their upper structures of sun dried brick. No stone is to be found in Seistan, and the absence of stone deprives the country of the lasting monuments of a very remote past, which stone buildings would have afforded.

One would hardly expect great age in mud brick buildings, but some of those in Seistan must be of very respectable antiquity, as I hope to show you. We must remember three things in connection with them, *i.e.*, that their walls are very thick, that the soil of Seistan makes bricks of wonderful excellence and durability, and, thirdly, there is little or no rain in Seistan to cause the destruction of buildings. The rainfall is only from two to three inches in the year.

The chief enemy of Seistan ruins is the wind which blows with terrific force and from always the same direction, a little west of north, more or less throughout the year. All the old ruins of Seistan, except the few circular ones, are orientated at exactly the same angle, *i.e.*, the angle of the wind. Their long side walls are in the same direction as the wind, and their shorter end walls at right angles to it. You will see from the photographs I shall show you how the wind has undercut the ruins, just as water action would do, and how in places the end walls have been entirely blown away leaving only the side walls standing. In places, solitary pinnacles are all that the wind has left of extensive old buildings.

I will now show you a few typical specimens

of the ruins I have talked so much about. I have already mentioned that the Helmand has three or more deltas in Seistan and has swung from one to another several times in the course of past ages. The population has naturally had to follow the river, and thus in turn each portion of Seistan has become the cultivated and populated one, while the other portions have been abandoned. The history of the country is, therefore, largely the history of the river, and in the past changes in the course of the river we have some clue to the age of the ruins in each delta. I will take them in turn, beginning with the delta now used by the Helmand, the inhabited tract of the present day. This has been the inhabited portion of Seistan for many centuries—ten or more. In it we find the present capitals of Persian and Afghan Seistan, the ruins of several recent capitals, such as Sehkoha, and a crowd of comparatively modern ruins, such as those of Jelalabad. Here, too, we find Zaranj, the capital of the Arab period, the place so fully described by El Estakri, who visited it about 900 A.D. It was destroyed by Timarlang about 1400 A.D. It is now known as Zahidan. Its ruins cover many square miles. The old citadel, of which I show the photograph, is the most prominent portion of them.

Close to Zahidan is a striking old monument of the past in the Mil-i-Kasimabad, a lofty minaret, of which the existing portion is 76 feet high. It is an exception to the general rule of Seistan ruins, being made entirely of burnt bricks, and these of very small size. The two cufic inscriptions round the top were photographed by us and sent to the British Museum for translation. Mr. Ellis, who has kindly translated them, states that the lower one bears the name of Malik Tajuddin, Abul Fazl-i-Nasr, and the upper one that of his grandson, Taj-ud-din Harab. The former evidently began the pillar, and the latter finished it. It was probably built by the former to celebrate his throwing off allegiance to the Saljuks, and proclaiming himself an independent king. This occurred in 1056 A.D. Thus the old minaret is contemporary with the Norman Conquest of England. The dilapidated condition of the pillar is due to efforts having evidently been made at some past period to destroy it, and the modern Seistani has done his best in the same direction by removing bricks from the base for building purposes.

Besides these ruins of comparatively modern date we have in the present used delta of Seistan many shapeless old mounds of buried burnt bricks, marking the sites of towns of far greater age. Since they were built the Helmand has doubtless deserted the present delta to which it has once more returned. Nad Ali is one of these. It is known as Bina Kai, *i.e.*, built by Kai, and is said to have been the capital of this old forefather of Cyrus and Darius. Another of his supposed buildings is known as Kai-ko-bad, on the banks of the Helmand above Bandar-i-kamal Khan. Here nothing but some pinnacles of old ruins now remain.

At Karku is an interesting old ruin of which little but the base remains, but that, like many of the older ruins of Seistan, is made of burnt bricks of immense size. There is every reason to believe that this is the old fire temple of Karkoi, one of the four most celebrated and ancient of the Zoroastrian fire temples. Old Parsi tradition attributes its construction to Afrasiab and its later restoration to Kai Khusro (Cyrus). Of the Zoroastrian religion we have traces in old ruins of fire temples and Dukmas or towers of silence.

Now let us turn to the southern and disused delta of the Helmand, *i.e.*, the Tarakun Ramrod tract. There is little doubt that this was the delta used by the Helmand immediately previous to the existing one. Long after the river last deserted its old bed through this tract and swung northwards into its present course, the people struggled to maintain themselves then by maintaining sufficient water for irrigation by a weir at Bandar-i-kamal Khan and a long canal from that point. Timurlang is said to have destroyed this weir.

The tract is now a desolate waterless waste. We find in it, as elsewhere, many ruins, some comparatively modern, such as Hauzdar, others of much greater age, such as Tarakun and Ramrod, of which I show you pictures. Ramrod is commonly supposed, and I think with truth, to be the Ram Shahristan which the Sassanian King Varakran II. built after driving the Scythians out of Seistan in 275 A.D. That again was said to be on the site of Agriaspa, the capital of the country when Alexander visited it in 330 B.C.

The Helmand probably did not itself use this delta throughout the whole of the period this tract was last inhabited, for we find traces of extremely ancient canals leading into it from as far up the Helmand as Rodbar. The chief of these is known as the canal of Gurshasp, who was a forefather of the mighty

hero Rustam and himself a hero of ancient legend.

This suffices to give this tract some claim to antiquity, but a very interesting discovery which we were fortunate enough to make in this delta during the stay of our mission in Seistan, takes us back into such distant ages that the time of Rustam appears but a thing of yesterday. Here in the tract all round Ramrod are numerous mounds, covered with black pottery of the kind attributed to the early days of mankind and which marks so to speak the dawn of civilisation. Here too on these mounds are traces of a still earlier age in the form of palæolithic stone implements. These old human relics take us in one jump from the two or three thousand years of the Rustam age to the many tens of thousands of years of the palæolithic age. All we have to mark the vast intervening ages are the bits of black pottery and the bits of the more recent but still extremely ancient red pottery which are to be found in enormous quantities all over this portion of this Ramrod delta.

We have yet one more delta to visit. This is the eastern portion of Seistan, a howling desert wilderness of sand-hills and clean swept plains. Here we have found nothing as old as the palæolithic relics of the Southern delta, but we have innumerable ruins of an interesting kind. We were the first Europeans to visit this series of ruins. The largest of these is Sar o Tar. It bears evidence of great age. It consists of an inner fortress or citadel, of circular form, on a mound round which was a town surrounded by fortified walls. Outside that again, and enclosing a large area of ground, is another surrounding line of high fortified walls. Much of this and surrounding ruins are covered by sand.

To what period to assign these ruins it is difficult to say with confidence. I am inclined to think that this was the capital during the period of the Indo-Parthian kings who, we have every reason to believe, reigned for a time in Seistan. Many Indo-Parthian coins are found here. Many legends centre round Sar o Tar. Among others, there is the story of a demon who lived in the citadel of that place in the form of a fox. He is said to have destroyed both men and crops, and to have been driven out by a holy man some 1,700 years ago.

Another legend makes Sar o Tar the abode of an Indian Prince, Raja Sispal, and it is a very curious fact that many of the neighbouring ruins still bear Hindu names. We find here the forts of Thakur Das and Tahil Das, and so on.

One very remarkable feature of the Sar o Tar ruins is the fact that the pottery, china, and glass, of which broken bits abound in huge quantities, are of a very high order of excellence, far superior to any found elsewhere in Seistan. From here, too, come the greater portion of the many beautifully cut seals and intaglios which one sees in Seistan. These old relics, the buildings, and the elaborate canal system of which traces are still visible, show that this tract was the centre of life in, perhaps, the most prosperous, wealthy, and civilised period of Seistan history.

The ruins in the southern portion of this tract are mostly buried in sand; but those of the northern portion are free of sand, such as Amiran, Kila Surkh, and others, and are in a state of wonderful preservation. At Amiran is an interesting old shrine, where is said to repose the remains of an ancient holy man, who was killed by one of the chiefs of the Ashg race, whom we have reason to suppose are the Indo-Parthians before mentioned. Sir Henry Rawlinson, writing in 1872, speaks of a very ancient minaret said to be at Amiran. The picture I now show you of this minaret shows how it differs in character from anything else in Seistan. It has a distinctly Chinese character. Of its history we know nothing.

Besides the deltas, past and present of the Helmand the other Seistan rivers have their deltas, and in each are innumerable ruins. The principal of these are the very extensive ruins of Peshawaran in the now disused delta of the Farrah Rod river. Here too we have ruins of many different ages.

Time forbids my dwelling further on the relics of the past in Seistan. Much valuable results await those who may hereafter take up the thorough examination and systematic excavation of these ruins.

I must come now to the Seistan of the present, and it is my painful duty to point out how widely the Seistan of to-day differs from that of the past. The face of the country, its scenery and even its climate must have changed since the days of Seistan prosperity. To understand this one must realise what those who have studied such questions know to be a fact, *i.e.*, that on man and on the work of man depend largely not only the appearance but the character of a country and all that concerns it, its flora, fauna, and even climate. With population and civilisation cultivation takes

the place of deserts, swamps and forests, while malarial diseases and animal pests disappear. Those who know what has happened through human agency in America, Australia, and elsewhere, know how even the climate imperceptibly changes by the mitigation of extremes.

The reverse side of the picture is still more striking. No virgin desert is ever so desolate or so terrible as large cultivated tracts in an arid country deserted by man and abandoned to nature. Nature takes a terrible revenge in such cases. Where water exists noxious weeds take the place of crops, insects and animal pests multiply and with them disease. Where water is absent vegetation dies out, the winds scour the surface of the land, remove the softer soil of civilisation, and the invading sand covers all before it.

This is what has happened in Seistan. You have seen in the pictures of old ruins the scene of wild desolation where civilisation once thrived. The present inhabited and cultivated portion of Seistan is but little better It is true that the soil is so wonderfully fertile and the Helmand water so abundant that rich harvests of grain are there obtainable with the minimum of labour. So much is this the case that the produce of the country, after supplying the needs of its 200,000 inhabitants, leaves a very large annual surplus. This surplus might very easily be very largely increased, but this requires reform in the administration of the country. Until those who sow are guaranteed their fair share of the harvest, and until the possession of wealth ceases to be a source of danger and ultimate ruin, it is to the interest of no one, great or small, to extend cultivation or grow more than is required for immediate needs. Seistan might be made one of the richest grain-producing districts in the world.

With all this natural wealth at his door, the Seistani of to-day is, however, a very impoverished individual. He lives a hard life amidst squalid surroundings. He is content to dwell within sight of the ruins of the imposing buildings of his ancestors in miserable hovels. The best of them take the form of domed houses grouped into a village built generally on a mound. These often look picturesque from a distance, but are dirty and squalid on nearer approach. In the larger portion of the country villages are merely groups of wattle and daub huts. A large portion of the population are cattle and sheep owners. These either live in wattle and daub huts or more often in encampments of black blanket tents.

The Sayads, a curious aboriginal race, who live in the reed beds skirting the Hamuns and who make their living by netting duck and fish, live a wild animal sort of existence in huts made of bundles of reeds.

The present capital of Persian Seistan is Nasratabad.* No better illustration of the present degeneration of Seistan can be afforded than its capital, Nasratabad, with its broken-down walls, dilapidated gateways, and dirty squalid interior. The luxury of the past ages of Seistan, of which we find abundant evidence in the enormous quantities of broken pottery, china, and glass strewn over the face of the country, in the beautifully inscribed seals of agate and other stones, and in curiously worked copper utensils and ornaments, and so on, appears to have entirely died out. Instead of the beautifully made pottery and china of the past, the Seistani of to-day has only rough pottery of the simplest kind, and very little of that. Glass is unknown, and the empty bottles left on our camping grounds were keenly fought over as priceless treasures. His clothing is rough cotton cloth, made of home-grown cotton, and round every village and encampment are little groups of primitive looms, where the weavers sit in the open and work under the shelter of a hedge or an old wall, to protect them from the Seistan wind. The only remnant of ancient art in this country is the making of little carpets and saddle-bags. These are still largely made in the encampments of the cattle and flock-owners, and are often most artistic and tasteful both in pattern and colour.

The population of Seistan forms an interesting study in itself, but space forbids my dealing with this subject at any length. We have, it is believed, in Seistan remnants of some of the very earliest Aryan races in their purest form. With them we have also a curious conglomeration of many and varied races. Some are descendants of early conquerors of the country, who have been left stranded here by some receding tide of conquest. Others are remnants of tribal colonies, who have come in to settle in the country when devastating hordes had departed leaving it depopulated. To show how interesting but yet difficult the study of the ethnology of Seistan is, I may note that

* It is, however, never known as such by the people of the country, who call it Shahr i Seistan (City of Seistan), or simply Seistan. This is a relic of past custom. For very many centuries the capital of Seistan was called Zaranji, after the formsr name of the country, Zarangiana, and it would seem that more than one capital was thus known.

our recent researches show the existence of no less than some 137 different races and tribes in the present population of the country. Aryans, Scythians, Mongolians, Indo-Parthians, Arabs, and Turks are all represented there.

For practical everyday purposes we may group the population under three main heads, Persian, Beloch, and Brahui. Afghans form an infinitesimally small portion of the people even in Afghan Seistan. It is interesting and also important to note that a considerable number of the Beloch and Brahui population have come from what is now British Beluchistan and belong to tribes living in British territory.

Seistan has been forgotten by the outside world for many centuries and has only recently come to general notice. As recently as ten years ago, when in completing the demarcation of the boundary between Afghanistan and Beluchistan, I arrived at the southern corner of Seistan, that country was cut off from all contact with the outer world and there were no foreigners of any kind in the country. Between it and India lay 500 miles of almost waterless desert which had seldom been traversed. Trade with Seistan did not exist. In those ten years the situation has greatly changed. Russia suddenly evinced a lively interest in the country and we have equally suddenly realised its great importance. Where ten years ago no foreigners existed we now have a British Consulate, a Russian Consulate, a Customs-house under Belgian officers, and no less than two banks, *i.e.*, a branch of the Imperial Bank of Persia, which is a British concern, and a branch of the Russian bank.

Trade between India and Seistan, also between India and Persia through Seistan, has steadily increased notwithstanding the efforts of our Russian rivals to suppress it, and notwithstanding a custom tariff which seems singularly disadvantageous to it.

The survival and still more the gradual expansion of our trade under such adverse conditions is the more remarkable when one considers the way in which our Russian rivals foster their trade. Not only are traders in Russian goods favoured by a premium to cover the cost of carriage, a very expensive item, but the Russian Bank, which is directly under the Russian Government, is in itself a trading concern. It fulfils the functions of a wholesale warehouse greatly to the benefit of retailers of Russian goods.

Our bank, which it must be remembered, is a private company, and not a Government concern like the Russian Bank, although it has done so much throughout Persia to raise British prestige and facilitate trade, is a bank pure and simple, and deals in money and not in goods. It can never, therefore, benefit and assist retail trade in British and Indian goods like the Russian Bank assists Russian trade.

The success of trade with Persia is mainly a question of communications and transport. Such success as we have already gained in trade with Eastern Persia is due to the opening of the trade route from Quetta to Seistan. The 500 miles of trackless and almost waterless mountain and desert between those places has by the enterprise of the Indian Government, and by the energy of Major Webb Ware and other able Indian political officers, been traversed by a well marked-out road along which are stages provided with wells, comfortable rest houses, and provision shops. It is a well-guarded and safe road, and has now the advantages of a telegraph line and postal system along it. The first hundred miles—*i.e.*, from Quetta to Nushki, over high mountains, which was the most difficult part of the route, especially for camel transport—has now recently been traversed by a railway line. The opening of this line should be marked by a very considerable increase in trade with Persia, and it is devoutly to be hoped that an extension of this line may some day still further curtail our distance from Persia, and increase our trade with that country.

So much for the past and present of Seistan. Its geographical position and great natural resources destine it to play in the future once more an important part in the history of the East. The ideal future which we devoutly hope it may attain is a return to its ancient prosperity under a strong and rejuvenated Persia on the one side, and an enlightened Afghanistan on the other. That is the ideal to aim at, the ideal to promote by assistance and encouragement. Ideals, however, are sometimes never attained. With the one in question our Russian rivals seem to evince little sympathy. Any failure in its attainment will be due to them, and it is only wise for us to take good care and safeguard ourselves from the evils which the non-attainment of our altruistic ideal threatens to bring about.

If there be any who question the importance to Persia, Afghanistan, and our Indian Empire—politically, commercially, and strategically—of Seistan, I earnestly urge them to study the history of Russian endeavours, past and present, to forestall us in that country.

DISCUSSION.

Sir LEPEL GRIFFIN, K.C.S.I., said he presumed the only reason he had been called upon to speak was because of the fact that the latest building in Seistan appeared to have been built by him, the building of doubtful beauty shown on the screen which represented the Seistan branch of the Imperial Bank of Persia. He was sorry to say that the building had cost the Bank a good deal of money during the past two years, and he could not say that its aspect, as shown so graciously by the author, filled him with any satisfaction at present. The paper had been of so interesting and so fascinating a character that he would not like even to interpose one word of criticism on its subject-matter; but, as he had been invited to speak, he wished to say that they all desired to see the Nushki route a success. No one had greater sympathy with the energetic action of the Indian Government in opening that route than himself, but experience so far had not shown that the route was likely to be a successful one, the trade along it being infinitesimal. So far as his experience went, there was no population in Seistan which justified any banking facilities. What the Russians might do with their wholesale and retail traffic in their own bank he did not know, but certainly the branch of the Imperial Bank of Persia, of which he happened to be the chairman, had sustained nothing but loss in its intercourse with Seistan. The population having scarcely progressed beyond the stage of barter, and the estimated cash in the possession of each person in Seistan only amounting to about 1s. 3d., it could readily be imagined that banking was one of those operations which was represented by the ideal so eloquently spoken of by the author than by anything in practice. There was one point on which he ventured to differ from the author. He was quite certain there were a great many present who would agree with him when he said that one of the principal lessons that should be learned from the Russo-Japanese war was the value of railway-power, as represented by the Siberian line, as against sea-power. He desired to impress upon the audience that Great Britain held the sea-power, not only in an offensive and warlike point of view, but as commercial traders carrying the commerce of the whole world. England's power commercially was on the sea; and he urged upon the Government to dissipate neither strategically nor commercially that power by substituting rail communication, which would certainly fall in the time of war into the hands of their enemies, for the sea communication which they had in their own hands, and which gave them the whole of the profits. He was, and always had been, opposed to any extension of railway communication through Afghanistan to Persia, and without desiring to be dogmatic he thought that was one of the vital questions of world policy which it would be a very good thing for every Englishman thoroughly to study, and to come to a decision upon in his own mind.

Mr. T. HART-DAVIES, M.P., desired to express his admiration of the most interesting paper which had been read. He had been through Persia but not to Seistan, but after hearing Sir Henry McMahon's paper he was possessed with an earnest desire to see the magnificent ruins of which photographs had been shown. He desired to ask two questions: In the first place, what was the language of Seistan, and, in the second place, whether there were any inscriptions on the ancient buildings, and, if so, in what form they were written.

Mr. MARTIN WOOD thought the paper was a peculiarly picturesque and interesting one; more especially it was very much of the nature of a rediscovery of the ancient and mediæval history of the now forlorn country of Seistan. The story of the author's mission in the country, of the endurance, the intrepidity, scientific skill, and resources at the disposal of the Indian Government amongst its officers, had been strikingly brought out. With regard to the practical object of the work, the extension of the railway from Nushki to Seistan itself, it must not be forgotten that all these proposals went right outside of India itself. Nushki was nearly a hundred miles even from Quetta, and outside of the region for which India had any natural affinity; and yet three-quarters of a million of money had been spent upon a railway which could never pay its working charges, much less make any profit. Nushki is 150 miles beyond our true boundary at Jacobabad, and almost 300 miles from our frontier higher up at Dhera Ghuzi Khan. It was quite desirable, however, that Indian traders should be in communication with the country, but it appeared to him that the railway had been promoted on the wrong principle. The early Punjab frontier officers were desirous of having communication with the countries beyond, and of encouraging trade, and succeeded to a large extent in attracting the people outside to come into India with their goods and caravans; but these officers' methods were different. They sought by annual fairs and other facilities to induce Seistanis and Afghans to come inside our border instead of our roaming after them, and thus avoided the enormous expense and risk that had followed from the aggressive policy which had injured India for so many years, and of which the railway of Nushki was another instance. It was to be hoped that that policy would not be pushed much farther, because the story of the Mission itself and the railway exploitation were such as to discourage further perseverance in that kind of progress for increasing the trade of these countries.

Mr. ABDUL MAJID thought the audience owed a debt of gratitude to the author, not only for the paper he had read, but also for the accomplishment of a most difficult task in the fixing of the boundary between Persia and Afghanistan. Sir Henry McMahon was not one of those who contented themselves with

aking a passing interest in the affairs of the East, but had rendered active service in the development of the Empire. The plans of Russia were plain, and it was no secret that she had designs upon India; the occupation of Panjdeh, and the construction of railways to the north all loudly proclaimed her intentions. Statesmen like Lord Curzon, who had interested themselves in the problems of the East, had come to the same conclusion. Sooner or later a conflict between Russia and England was inevitable, and in the face of that fact any man who did the least in placing a barrier between Russia and her designs deserved their most hearty thanks. Sir Henry McMahon had done so in the work he had carried out, by removing a pretext which might have been seized upon by Russia in regard to the settlement of the boundary question. But when the struggle came, if England only studied the feelings of the Indians, she would have not only the support of the Indian soldiers, but of the whole of India. India had never grudged the shedding of her blood in the cause of England.

Sir HENRY McMAHON, in reply, regretted that his casual reference to the railway question should have called forth so much discussion, because he did not wish that matter to be confused with Seistan and its ruins. The railway question was very much like all other questions, in that there were two sides to it, but he did not propose to be drawn into a discussion of the railway. He sympathised with Sir Lepel Griffin in regard to the absence of the sea in Seistan; it would be a better country if the sea were there, but failing the sea they must get there somehow. He thanked Sir Lepel Griffin for his kind remarks, and hoped for a brighter future for the Imperial Bank of Persia in Seistan. The building, at any rate, was setting a new ideal in architecture in the country. Mr. Hart-Davies had asked him to mention the language of the country. As there were numerous tribes there were numerous languages. For instance, there was the modern Persian of Persia, and there was also an old form of Persian in Seistan, as one would expect from the presence there of pure types of the old Iranian stock. He came across many old words and expressions which Persian scholars told him were quite archaic. In addition, the Baluchis spoke Baluchi, the Brahui spoke Brahui, and the Afghans spoke Pushtoo. The Linguafranca was the modern Persian of to-day. With regard to the inscriptions, he regretted to say that the only inscription found on the buildings was the one in Cufic character on the minaret of Mil-i-Kasimabad, of which a view had been shown, dating about 1056 A.D. He also found one or two memorial tablets to departed local celebrities of 1,000 or 1,200 years ago, but they were not interesting.

The CHAIRMAN, in proposing a vote of thanks to Sir Henry McMahon for his intensely interesting paper, said that the author had referred to the previous Mission of 1872, which was undertaken by Sir Frederic Goldsmid. Sir Frederic Goldsmid had been asked to attend the meeting, but had replied that his age and infirmities made it impossible for him to do so. In expressing his regret, he added that if he had been able to be present he would not have failed to give testimony to the practical and excellent manner in which Sir Henry McMahon had done his work. In conclusion, the Chairman said he only desired to remind those gentlemen who had made remarks on the political future of the country that Sir Henry McMahon's paper was not on the future of Seistan, but on the past and present of Seistan.

The vote of thanks was carried unanimously.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 9th, 1906; COLONEL H. C. HOLDEN, R.A., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Brain, Charles Kimberlin, B.Sc., South African College School, Cape Town, South Africa.
Eranee, Pestonjee Cursetjee, Markur's-building, Apollo-street, Fort, Bombay, India.
Gobariya, Rai Sahib Pandit, Garbiyang P.O., District Almora, U.P., India.
Hofman, Professor J. Wesslay, D.Sc., State Normal and Industrial College, Prairie View, Texas, U.S.A.
Parsons, William, Bengal Chamber of Commerce, Calcutta, India.
Robinson, Mansergh Dias, M.Inst.C.E., care of the Engineer-in-Chief, Cape Government Railways, Cape Town, South Africa.
Row, T. S. Sama, 126 Coral Merchant-street, Madras, India.
Sessionwalla, Framroz Hormusjee, Grant-road, Bombay, India.

The following candidates were balloted for and duly elected members of the Society:—

Barr, Colonel Sir David William Keith, K.C.S.I., 40, Evelyn-gardens, S.W.
Bean, Alfred William, Singapore, Straits Settlements.
Cowan, Major Bryce William, D.S.O., Cowan's Post, Mafeking, South Africa.
Cowling, Charles Ernest, 7, Dolman-road, Aston-manor, Birmingham.
de Rymkiewicz, Baron Bromislau, 51A, Conduit-street, W.
Dupernex, Hubert Emile, 34, Ventnor-villas, Hove, Sussex.

Gallinagh, James P., Electricity Works, Limerick, Ireland.
Greig, Gordon E., Ipoh, Perak, Federated Malay States.
Hoeltzel, Dr. Max, Stafflenbergstrasse, 24, Stuttgart, Germany.
Iyer, T. Subramanya, Madras, India.
Jacques, Fred., Bangu, Ramel Sant Cruz, E.F.C.B., Rio de Janeiro, Brazil, South America.
Merson, Geo. O., Confederation Life Building, Toronto, Canada.
Mody, Ardeshir Maneckji, 107, Princess-street, Bombay, India.
Mudaliar, Rao Bahadur Bangalore Perumal Annaswami, K.I.H., 3A, Osborne-road, C. and M. Station, Bangalore, India.
Pantulu, Madapati Venkateswar Row, Nuzvid, Kistna District, Madras, India.
Parsons, John E., 52, William-street, New York, U.S.A.
Perrins, Charles Henry, Heilbron, Orange River Colony, South Africa.
Rowlatt, Frederick Terry, National Bank of Egypt, Cairo, Egypt.
Scott, Walter, The Powell Duffryn Steam Coal Company, Limited, Aberaman-offices, near Aberdare.
Treacher, Sir William Hood, K.C.M.G., Lawday-place, Farnham, Surrey.
Usher, Harry, Ferro Carril de Antofagasta á Bolivia, Antofagasta, Chili, South America.
Wyndham, The Hon. Hugh Archibald, P.O. Kromdraai Station, near Standerton, Transvaal, South Africa.

The paper read was—

THE USE OF CAISSONS IN BRIDGE BUILDING WITH REMARKS UPON COMPRESSED AIR ILLNESS.

By Thomas Oliver, M.A., M.D., LL.D., F.R.C.P.

Physician Royal Infirmary and Professor of Physiology, College of Medicine, Newcastle-on-Tyne.

Man's increasing wants and the needs of civilisations prompt human ingenuity, and lead to wider applications of science. The utilisation of steam and electricity has shortened distance and made travelling comfortable and a luxury to all. Long before steam was made subservient to man's needs, water and the forces of the atmosphere had been constrained to contribute to his wants. The diving bell originally employed and into which barrels of air were carried, was a primitive machine, but it was the forerunner of the diving bell of to-day, as well as of the modern caisson. For the use of compressed air and caissons we are largely indebted to Triger, a Frenchman, who employed them to reach a bed of coal underneath the river Loire. In recent years, no large bridge of notoriety has been built without caissons. In subaqueous work and in the making of tunnels, caissons have played an important part; and while engineering skill and daring have indicated how purely physical difficulties may be overcome, physiology has shown the lines along which operation may be conducted with safety to the workmen. Thus is it that engineering and medical science have mutually contributed to the production of some of the splendid results of human enterprise of modern times. While operations in compressed air are carried on in accordance with physical laws, we have to remember that the conditions under which these are conducted are unnatural to man, hence the occurrence of compressed air illness and the necessity for members of the medical profession to know how to prevent and treat caisson disease.

My experience of caisson disease has been gained at Newcastle-on-Tyne, during structural alteration of one of the bridges that span the river Tyne, and the building of the new high level bridge by the Cleveland Bridge and Engineering Company, now approaching completion. In order to support the enormous weight which this bridge will have to carry, the piers have had to be large, and to obtain secure and solid foundation for these piers, it has been necessary to excavate the soil in the bed of the river to the depth of 70 feet below high water level mark. The workmen, in their excavations have passed through strata of silt, gravel, clay, soft coal, &c. The size of the caissons which were successively in use, may be inferred from the fact that 35 men worked in each caisson at one time. These chambers measured 113 feet in length, 35 feet in width, and 9 feet 6 inches in height, and had a cubic capacity of 23,142 feet. The total number of days spent in caisson work was 267, and the total number of men employed was 150. 48 men worked under air pressure through the three caissons from start to finish without being affected; 29 men worked through two caissons or 180 days, and remained in good health; 49 men through one caisson or 90 days without symptoms. No man over 40 years of age was allowed to work in compressed air: 4 per cent. of the men applying for work were rejected at the primary medical examination, while 31 men, partly through fear and partly

through muscular pain, gave up the work within the first fortnight. The largest number of cases of compressed air illness occurred when the pressure employed varied between 24 and 30 lbs., and principally during the months of September and October. The Company brought 18 experienced sinkers with them to Tyneside. At the Greenwich tunnel 13·9 per cent. of the men applying for work were rejected at the primary medical examination. At Baker-street tunnel, the number of days spent in compressed air work was 157—of the 120 men employed, 28 worked throughout the whole period, and six almost the whole time: 13 worked half the period, 36 casually, and 32 worked for short periods less than ten days.

To understand what is meant by compressed air illness, a brief description of a caisson is necessary. In its simplest form, a caisson when in position, is an iron cylinder, somewhat bell-shaped at its lower extremity, and closed at its upper by a sliding door, which forms the ceiling of the chamber wherein the men work, and which separates it from what is known as the material lock, or the chamber through which the buckets filled with soil escape through the sliding doors, that constitute the roof of the caisson. Leading out of the upper part of the caisson, just underneath the ceiling already referred to, is a door which, when open, allows of entrance into another chamber called the airlock, and through which the men gain entrance into and emerge from the working chamber proper. If a caisson is large it may have two or three shafts or cylinders leading into it. It is not necssary to have the material lock on the same cylinder as the air-lock. In Amsterdam I found the soil was removed through a material lock on a different shaft to that by which the men entered and left the working chamber. This is known as the Zschokké Lock and is worked automatically. On the Tyne the caissons had three shafts, each with its own air and material locks. When built and placed in position, *e.g.*, on the bed of a river, a caisson is a pneumatic chamber which would swim but for the large amount of concrete superimposed upon it. Air under considerable pressure is pumped into the caisson to keep the water out of it and allow the men to work therein. The surplus air escapes by the cutting edge of the bell-shaped expansion and by this means ventilation is secured. In tunnel making, caissons are constructed in another manner since the line of procedure is not vertical but horizontal. Caissons have to be strongly built so as to withstand enormous air pressures. On one occasion a caisson burst in France and the inmates were immediately killed. When the necessary depth has been attained the caissons are filled internally with concrete, and they then become the foundations upon which the piers of the bridge are built.

Compression.

To enter a caisson, a workman must first pass through the air-lock. Having closed the outer iron door of this chamber, a valve is opened which allows compressed air to escape into the air-lock from the working chamber, and when the pressure inside the air-lock has become equal to that of the inner chamber, the door which separates these two, and which had been kept firmly closed owing to the high pressure, now opens practically of itself. Through this the workman passes into the shaft of the caisson, and descends by an iron ladder to the bed of the river, where excavation is proceeding. In passing through the air-lock, the men undergo what is called "compression." The rise of pressure should be gradual, especially in the case of men who are commencing caisson work for the first time, for although no serious effects are usually produced, symptoms of an unpleasant nature may be experienced. As a consequence of the rise of air pressure, the membrana tympani may be forcibly driven in, and the men may not only suffer extreme pain in the ear, vertigo and headache, but may become deaf. Permanent deafness and rupture of the tympanic membrane have occurred. These can be prevented by the men swallowing air and passing it up to the Eustachian tube into the middle ear, so as to equalise the pressure on the two sides of the tympanic membrane. Beyond these effects, which may be regarded more as unpleasant sensations than anything else, nothing is experienced by the men during compression. The abdomen shrinks, so that if a workman is wearing a belt, he generally tightens it.

Decompression.

Having finished their work, the men leave the caisson by ascending the ladder and again entering the air-lock, the inner door of which they close behind them. The pressure within the air-lock and the working chamber is, for the moment, the same, but by turning the handle of a tube, which communicates externally, air is gradually allowed to escape

from the air-lock outwards, and the pressure gradually falls. When the pressure inside the air-lock equals that of the external atmosphere, the outer door is opened, and the men emerge from the air-lock enveloped in a thick mist or fog, owing to the low temperature of the expanded air. In coming out of the air-lock, the men undergo what is called "decompression," and it is during, but more especially after decompression, that symptoms of caisson disease or of compressed air illness show themselves. Experience and experiment have alike demonstrated that it is rapid decompression that has to be guarded against, since it is responsible for much of the illness that occurs. The sojourn in the air-lock ought to be proportional to the length of time the men have spent in the caisson, the depth at which and the pressure under which they have been working. During the act of decompression the cold in the air-lock is often intense. The temperature may fall as much as 40 degs. F., and as the men have been previously heated by their work, the sudden chilling of the surface of the body may have a prejudicial effect. When in Amsterdam a few months ago, I was much gratified by seeing the workmen emerge from the air-lock each with a blanket-shawl round his shoulders and trunk, the gift of the employers. In order to reduce the risk of chilling of the body, and to make their period of confinement in the air-lock as comfortable as possible for the men, the Dutch employers heat the air-locks by electricity. This circumstance, coupled with the fact that the men are paid for the time spent in the air-lock, has diminished the impatience of the workmen, and made them more submissive to the length of time required to be spent in decompression, which in Holland is longer than in most countries.

The pressure inside the caisson is regulated in accordance with the depth the men are working at. In tidal rivers this pressure rises and falls. One pound of air-pressure displaces 2 feet 4 inches of water; in other words, 10 mètres of water are equivalent to 1 atmosphere of pressure, or, expressed otherwise, 1 atmosphere, *i.e.*, a pressure of 15 lbs. to the square inch, is required for every 33 feet of water. If men were working at a depth of 100 feet, 3 atmospheres are required, or a pressure of 45 lbs. to the square inch, inside the caisson. In speaking of pressure inside the caisson, the figure is always that over and above the normal atmospheric pressure of which no notice is taken.

Only skilled and careful workmen should be in the charge of the air-lock, and of the moveable doors inside the caisson, through which the excavated soil is removed, since the slightest carelessness and inattention to duty may be fraught with the most serious consequence to the lives of the men inside the caisson. In September of last year, during the building of the new pier at Havre, there was a sudden inrush of water into a caisson wherein men were working, owing to one of the doors of the caisson having been opened at the wrong time. As there was an immediate fall of air pressure, the water suddenly rushed into the caisson, and while the men rapidly made their way to the point of egress, one man had not time to reach the door-way and was unfortunately drowned.

Amount of Air Supplied.

On the river Tyne, the caissons employed were larger than those hitherto in use anywhere. Thirty-five men could work therein at a time. The amount of compressed air required to be pumped into a caisson is determined by the size of the chamber, the depth reached, the number of men working, and the rapidity with which the surplus air escapes by the cutting edge of the caisson. If a caisson has suddenly come to rest upon clay soil, the air will not escape so readily, ventilation will not be so perfect, and less compressed air will be required. In tunnelling, also in vertical sinking, the escape of air from the caisson is enormous, when the soil that is penetrated is gravel. At Newcastle, 1,320 cubic feet of air per man per hour were sufficient, but at the Blackwall tunnel, Dr. Snell found that to keep the workmen in good health, 4,000 to 9,000 cubic feet of air per man were necessary: owing to the gravelly nature of the soil at Blackwall the surplus air escaped readily. The number of men off ill varied with the amount of air supplied, as shown below:—

Free air pumped per man per hour cubic foot.	No. of days.	No. of cases.	No. of cases per 100 days.
Below 4,000	56	16	28·5
4,000 to 8,000	47	9	19·1
8,000 to 12,000 ..	71	8	11·2
Above 12,000 ...	41	0	0

At the Baker-street and Waterloo tunnel, London, the lowest amounts of air supplied were 1,300 and 2,000 cubic feet per man per hour, but under best conditions 13,000 cubic

feet per man per hour were supplied. When the best conditions of ventilation prevailed there were eight cases of illness in one month, but when the worst conditions prevailed there were 13 cases in 12 days. If the surplus air does not escape rapidly, CO_2 and other gaseous impurities accumulate in the air inside the caissons. It is still an unsettled question as to how far CO_2 and other gases do not contribute to the causation of compressed air illness. In passing through clay soil the amount of CO_2 in the London tunnels frequently rose to 0·1 per cent., whereas with a gravel face the percentage varied between 0·05 and 0·07. At Greenwich the CO_2 in the shield rose to 0·1 and 0·2 per cent. The CO_2 in the Hudson tunnel frequently rose to 2 per cent. or 20 parts per 1,000 of air, and the men died at the rate of 20 per cent. It is reasonable to suppose that impurities of the air in a caisson will under compression become more dangerous to health than at the normal atmospheric pressure, and yet while there is much to support the opinion that excess of CO_2 inside the caisson is responsible for the illness of the workmen facts do not always support the contention that it is CO_2 that is the cause of the malady. In London it was not when the men were working at a clay face, and the percentage of CO_2 highest, that the amount of sickness was always greatest.

In making the London tunnels the engineers tried to reduce the percentage of CO_2 by passing the compressed air through lime and caustic soda, or pumice stone soaked in caustic soda, but the air never became more purified than to the extent of 0·01 per cent.

In Paris oxygen regenerators for purifying the air were tried some time ago. When sodium dioxide is brought into contact with water the sodium compound decomposes, giving off oxygen. The sodium hydroxide which remains immediately absorbs the CO_2, forming sodium carbonate. No doubt under certain circumstances the oxygen in the air of a tunnel might by this means be renewed from time to time, but there is not the least doubt that the delivery of the purest air possible to the workmen is the only satisfactory solution of the problem, the pipes being carried forwards so as to deliver the air close to where the men are working, proper means being adopted for the removal of the surplus and impure air.

It occasionally happens in subaqueous operations that a caisson suddenly sinks on to a bed of clay, and as a consequence the surplus air can no longer escape by the edge of the caisson. When this happens, the caisson is said to rest upon a "water-tight" stratum. As the engine still keeps pumping air into the caisson and no air can escape, there would be considerable risk to the men's lives and to the security of the caisson were it not for the fact that there are escape tubes in the upper part of the shafts which act automatically when the pressure rises above a certain point. There is also a "cut-out" close to the engine which acts automatically as well. On the Tyne the safety valves were so arranged as to act immediately and automatically when the pressure rose ½ lb. higher than the maximum pressure the men were working at on any particular day. If, for example, the men were working under a pressure of 30 lbs. at low tide, and 35 at high tide, the safety valve would act automatically when the pressure rose to 35½ lbs. These safety tubes are also brought into use when the men are filling up the interior of the caisson with concrete, for then, as the surplus air can no longer escape by the lower part of the working chamber, it must do so by the tubes. Only in this way can adequate ventilation be obtained.

Purity of the Air Supplied.

The air that is pumped into the caisson should be drawn from as pure a source as possible. It may be only a coincidence, but on the river Tyne the greatest number of cases of illness occurred among the men employed on the night shift, when the hours of work were of exactly the same duration as those of the men on the day shift. Under all circumstances care must be taken to prevent the possibility of the air sent into the caissons becoming contaminated by gases generated from the oils used to lubricate the pumping engines, by keeping the cylinders of the engine cool by means of a jacket of circulating cold water round the cylinder, and by making use of only high flash oils, such (*e.g.*) as 560° Fahr. Not only may the gases generated from the lubricant during the high temperature at which the engine is running become a source of danger to the men, there is also the risk of explosion. At the Ryhope Colliery, Co. Durham, such an explosion occurred owing to the tube which carried the air from the compressing engine having become lined with a deposit composed of coal dust and the lubricant, viz., soft soap, mineral oil and water. In the South African mines the gases given off by the lubricating oils have been blamed for the ill-health of the workers. In the case

of collieries employing compressed air, the presence of coal-dust in the atmosphere and the possibility of its igniting so as to cause an explosion must be borne in mind. Wherever air is used for compressing purposes it should be pure and not taken from sources in close proximity to gas works, lime kilns, burning heaps of waste material, &c. Coal-gas as the illuminant for the engine-house should be interdicted since through carelessness or accident some such gas might escape and be drawn into the compressing engines.

Length of Shift.

The time spent by the men in the caisson is inversely proportional to the pressure. Experience has shown that as excavation proceeds and greater depths are reached, the pressure rises and the shift has to be shortened. At Newcastle there were a day and a night shift; the men worked on an average $10\frac{1}{4}$ hours, viz.:—

6 a.m. to 8.30 a.m.	=	$2\frac{1}{2}$ hours
9.15 a.m. to 1 p.m.	=	$3\frac{3}{4}$,,
2 p.m. to 6 p.m.	=	4 ,,
		$10\frac{1}{4}$

when the pressure was 25 lbs. The length of shift was shortened as the pressure rose to 35 lbs. Four hours was the longest time spent at a time in a caisson, and the geatest depth attained was 70 feet below high water level mark. At St. Louis, when the pressure was 50 lbs. one hour at a time was spent in the caissons. At the new viaduct in course of construction at Amsterdam I found the men working at a depth of 66 feet, and a pressure of 30 lbs. Here the men work on a four hours shift twice a day separated by an interval of eight hours.

Symptomatology.

Beyond experiencing such unpleasant sensations as deafness, pains in the ears, cracking noises and headache, the result of pressure upon the membrana tympani, which can be prevented by inflating the Eustachian tube, the men have no inconvenience in passing through the air-lock and undergoing compression. Although compression may be rapidly induced without bad effects, it is desirable that the pressure should be raised gradually. The symptoms do not occur in the caisson when the men are at work. It is astonishing how few accidents occur inside caissons. There ought to be, however, a sling inside each caisson, whereby, in the event of an accident, an injured workman can be hoisted to the air-lock instead of having to climb or be carried up the ladder. It is during, but oftener after, decompression that the symptoms of compressed air illness show themselves. So frequently is this the case, that if symptoms were to develop during the time the men are working in a caisson, the probability is that they would not be due to compressed air illness. The causation of caisson disease is intimately associated with the length of time consumed in decompression. If the time spent is short there is considerable risk. On coming out of the air-lock the men at first may seem quite well. A few minutes afterwards, half an hour or longer, some of them may be suddenly seized with severe pains in the limbs, the trunk, or abdomen, accompanied by vomiting and bleeding at the nose or mouth; or one of the men may be seen suddenly to fall, and to have lost the use of his legs; to be convulsed and excited, or to have passed into a state of unconsciousness. The muscular pains may be so severe that the men writhe in agony. The rapidity with which such nervous symptoms as paralysis and convulsions show themselves is a measure of the severity of the illness. Some of my own patients were excited and hysterical; others became maniacal. The paralysis of the legs usually passes off in a few hours or a few days; it may continue for ten or twelve months and then incompletely disappear or it may be permanent. The loss of power may be attended by loss of sensation, followed by marked wasting of the muscles of the limbs, and by the presence of ulcers on the heels. The bladder is usually affected even in the minor forms of paraplegia, and as the catheter has to be employed inflammation of the bladder is apt to be induced, an unfortunate circumstance, since it plays an important part in the future prospects of the patient.

What are the Symptoms Due to?

Men who are operating inside the caissons are working under abnormal atmospheric pressures: the work is hard, and while the purity of the air supplied depends upon the source from which it is drawn, the air that reaches the men may have become accidentally impregnated with gases that escape from the soil that is being removed, the ventilation thus becomes imperfect, and as a consequence the waste products given off by the men are not removed. The circumstances that contribute to the causation of compressed air illness are (1)

the amount of pressure, (2) purity of the air supplied, (3) length of shift, (4) the state of the health of the men at the time, and (5) rapidity of decompression. While admitting that high pressure *per se* may become a source of danger if men are too long exposed to it, the fact remains that many of the men who became ill did so when they were working under low pressures. At Greenwich, for example, out of nine cases of compressed air illness three occurred when the men were working at only 12 lbs. pressure, and at the Blackwall Tunnel several of the men became ill even at a stiil lower pressure. One of my patients, a man who unfortunately died, had been immersed in a pressure of only 25 lbs. Snell's experience of the men remaining free from illness when plenty of air was supplied to them is extremely interesting. The cases fell from 28 in 100 days, when 4,000 cubic feet of air per man were supplied to 0 cases when the air supply reached 12,000 cubic feet. The percentage of CO_2 inside the caisson tends to rise with the length of time the caisson is occupied. Copperthwaite maintains that the percentage of sickness is proportional to the percentage of CO_2 in the air, and that when the CO_2 reaches 1 per cent. illness is to be expected. ("Min. Proc. Inst.C.E. vol. cl.") It is a question of the purity rather than of the amount of air supplied. At the Brooklyn Bridge 180,000 cubic feet of air per hour were delivered to 125 men working at a pressure of 36 lb., and the per centage of CO_2 in the air of the caisson was 0·3. The amount of CO_2 was in excess of what it ought to have been. This is not surprising, perhaps, since only 1,200 cubic feet of air per man per hour were supplied. At Newcastle, most of the cases of compressed air illness occurred when the men were excavating a layer of soft coal, from which disagreeable gas was given off, probably H_2S. At this time, the men were not working under a high pressure. Not only were there more cases of muscular pains, but the symptoms generally were more severe. It was during the removal of the silt from the bed of the river that at the Forth Bridge most cases of illness occurred. This did not occur at Newcastle.

In the French "Bulletin de l'Office du Travail," Fev. 1906, the divisional inspector of the 2nd circumscription draws attention to the fact that during the building of the bridge across the Loire, at Orleans, the foundations of which were secured by using compressed air, there were seventy-two cases of compressed air illness. No mention is made of the number of men employed, of the pressure they worked in, or of the severity of the symptoms, but the inspector expresses his regret that no preliminary medical examination was made of the men previous to their undertaking work in caissons. The inspector of the Havre division reports that during the sinking of two caissons in the construction of the pier, several cases of illness occurred, as certain kinds of soil were being excavated, owing to the gas which escaped entering the caisson, and by impairing the health and resistance of the men it made it impossible for them to bear increased air pressures. During 1904, there were fifteen cases of illness. One of the workmen was still disabled, and was likely to be permanently unfit for work, while other three had not quite regained their health.

During the concreting or filling up the interior of the caisson with cement, CO_2 is apt to be given off in considerable quantity. When the men were thus employed, and under a pressure of 30 lbs., a fairly large proportion of the men suffered at Newcastle. Occasionally, the percentage of CO_2 in a caisson may rise to O_2 and O_3. We can scarcely doubt that under these circumstances some harmful influence must be exerted by the impurity of the air, and yet, if the malady is due to an excess of CO_2, we should expect that symptoms would develop before decompression is commenced. When animals are exposed to very high pressures of atmospheric air, the oxygen of the air may become a cause of poisoning, and the animal may die in convulsions before or shortly after its removal from the compressed air chamber, or it may live for days and subsequently die from inflammation of the lungs. It is the presence of oxygen in the air that determines to some extent the limits of pressure which can be borne by man and animals. In my own experiments I found that mice, after an exposure to 10 atmospheres of oxygen, suffered from rapid breathing, became comatose, and died in convulsions before decompression was attempted. These symptoms and the stage at which they occurred, show that the animals did not die from compressed air illness, but from oxygen poisoning. Animals can be exposed for a similar length of time to higher pressures of ordinary atmospheric air than to oxygen without convulsions occurring, since the period is not sufficient for oxygen poisoning to occur. The consequence of exposure to high pressures of oxygen and to

high pressures of ordinary atmospheric air are not exactly the same. Oxygen is a protoplasmic poison, it lessens the respiratory exchange and induces convulsions. What is attempted in normal respiration is not simply the getting of oxygen into the blood and tissues, it is also the removal of CO_2 from them. It is this interchange the excess of oxygen disturbs.

Lorrain Smith found that "exposure of animals to a tension of 170 to 180 per cent. atmospheres of oxygen causes, in a short time, diminution in the power of the lungs to absorb oxygen actively, and that, with a continuance of this exposure, the arterial oxygen falls till it reaches the level for which mere diffusion of oxygen from the alveolar air might account." This result is largely due to the fact that oxygen has an irritating effect upon the lungs, and produces, first, congestion of these organs, and subsequently hæmorrhagic exudation and consolidation of them. The lungs become hepatised as in pneumonia: in the exudate in the alveoli and small bronchi, numerous polymorpho-nuclear leucocytes, cocci, and desquamated epithelial cells are found. Lorrain Smith, finding that such high pressures as 180 per cent. atmosphere of oxygen caused death in 24 hours, and that 300 per cent. produced inflammation of the lungs in five hours, is of the opinion that inflammation of the lungs is a cause of caisson disease. Such a theory cannot explain the fact that nearly all the cases of compressed air illness occur shortly after the men come out of the caisson, and that the symptoms are mostly in the muscular and nervous system, and not on the side of the respiratory organs. The highest pressures that men have been exposed to in caissons is, according to Lorrain Smith, 4·45 atmospere of air, or nearly 67 lbs. pressure. In this pressure the men only worked for about an hour at a time. An interesting series of experiments has been carried out by Leonard Hill and M. Greenwood, Hill exposed himself to a pressure of 75 lbs. and Greenwood to 92 lbs. Greenwood was in the compressed chamber for 54 minutes, and he was allowed 2 hours and 17 minutes to become decompressed. Notwithstanding the length of time spent in decompression, he experienced severe pains twenty minntes after leaving the caisson, all of which had disappeared one hour and a half afterwards.

Leonard Hill exposed a monkey for several days in succession to 8 atmospheres of air from four to five hours at a time, without inducing signs of lung trouble, and Paul Bert found that dogs could be exposed to 10 atmospheres of ordinary air for a lengthened period without bad effects so long as one to one and a half hours were spent in decompression.

Under ordinary circumstances of caisson work there is no danger from oxygen poisoning nor from pulmonary troubles, since the pressures under which the men work are not sufficient to give rise to the high oxygen tension upon which symptoms depend. What then is the effect of breathing impure air? Since, for example, CO_2 and H_2S are poisonous at ordinary atmospheric pressure, the respiration of these gases in the compressed form cannot be less but more poisonous. So far as working in compressed air is concerned, the danger, to some extent, must depend upon the rapidity with which the various gases can be dissolved in the blood and liquids of the body. CO_2 is readily absorbed by water to the extent of 66 per cent. by volume.

Physiology and Pathology of Caisson Disease.

In subjecting frogs to compressed air, and watching with the microscope the circulation in their web drawn over the window of the chamber, there is not detected when the pressure is suddenly raised any change in the rate of the flow of blood through the capillaries, nor any alteration in the calibre of the vessels, and as this is so uniformly the result it may be safely asserted that during compression the circulation is practically not affected. If there is any slowing at all, it is momentary. It is after rapid decompression that results are obtained, which, since they occur in men after they come out of the air lock and experimentally in animals subjected to the same conditions, we cannot but regard as the anatomical conditions that underlie compressed air illness. On rapidly decompressing a frog, and watching the circulation through its web, nothing is immediately observed, the circulation goes on just as before, but in three, four, or five minutes afterwards, the circulation is noticed to become slower, the blood corpuscles to oscillate, first in one direction, and then in the other, now forwards, now backwards, and there appears a bubble of air inside a blood vessel, then another bubble or two appear, these fuse together, so that sooner or later, a considerable portion of the blood vessels is filled with air. It is the presence of gaseous emboli in the blood vessels, the accompanying

stagnation of the circulation, and the occasional rupture of small blood vessels and hæmorrhage that are the pathological conditions present in most cases of compressed air illness. These occurring in the nervous system explain the sudden death of divers and caisson workers, and the paralysis of the limbs that is observed in men a few minutes or some hours after they have left off work. On opening the bodies of men and animals who have died under these circumstances, the blood in the heart and large blood vessels is observed to froth, and numerous small vesicles of air are seen in the brain and spinal cord, and since nitrogen forms the largest percentage of ordinary atmospheric air, the probability is that it is this gas which plays the most important part in the symptomatology of the disease.

Prevention.

Since the longer a person is immersed in compressed air, and the higher the pressure he is exposed to, the greater must be the amount of air absorbed and retained in solution in the blood and liquids of the body, so the more apparent is the necessity for shortening the shifts, and the length of time spent by the men in the caissons as the pressure is increased. Four hours, even under such low pressures as 20 to 25 lbs. are quite long enough. This was found to answer well enough at Newcastle, and it is the length of time allowed in Holland, when the men are working at a depth of 66 feet and in a pressure of 30 lbs. It is when the men are subjected to too rapid decompression that danger arises. The difficulty is to get the workmen who are coming off their shift to recognise the necessity of slow decompression. One minute for every 5 lbs. of pressure or three minutes for each atmosphere was the time allowed on the river Tyne for decompression. To some physiologists this is too short a time, and it is certainly short when compared with the 40 minutes required in Holland for the decompression of men who have been exposed to two atmospheres. Hill and Macleod recommend :—

Atmospheres	Pounds.	Shift.	Decompression period.
+ 2	30	4 hours	30 mins. to 1 hour
+ 3 to 4	45 to 60	4 hours	1 hour to 2 hours
+ 5	75	1 hours	1 hour to 2 hours
+ 6 to 7	90 to 105	½ to 1 hour	2 hours

No workman should be employed without having been previously examined by a medical man. No man who is addicted to alcohol, or one who is subject to catarrh of the nose and throat, or who has a weak heart and lungs should be employed. Experience has shown that young men between the ages of 20 and 30, who are temperate, whose tissues are still elastic, men who are of spare rather than of stout build, not only do the work better, but are not so liable to caisson disease. Snell's experience, as seen from the subjoined Table, is confirmatory of the opinion I have just expressed :—

Proportion of Sickness among Men of Different Ages.

Men's Ages.	No. of Men Examined and Passed.	Cases of Sickness.	Cases per Cent.
15 to 20	55	0	0
20 to 25	145	15	10·3
25 to 30	152	37	24·3
30 to 35	91	19	20·9
35 to 40 ..	61	14	22·9
40 to 45	38	10	26·3
45 to 50	3	5	166·0

Treatment.

For muscular pains, rest in bed and warmth, and when severe, hypodermic injections of morphia may be required. Nothing gives such rapid and lasting relief as placing the men back again in the air-lock and recompressing them. There ought to be a medical air-lock close to the caissons, large enough to accommodate two or three men in the recumbent position, and it should be kept comfortably warmed. If workmen, who are ill, are to be re-compressed, the compression should be made without delay. While this gives almost immediate and permanent relief in cases of muscular pains, and in minor forms of loss of power, it is impossible to say how far it is capable of doing good in the severe type of nervous symptoms, where paralysis is pronounced and extensive. H. von Schrotter has on theoretical grounds suggested that caisson workers should have the nitrogen in their blood, which has been absorbed from the atmospheric air under high pressure, washed out by breathing pure oxygen for five minutes before decompression. The suggestion has been proved to be practicable in the case of

animals. Under the average pressures in which men work it is scarcely called for. If pure air is supplied to the men and plenty of it and the shifts are not too long, there is not the least doubt that work in compressed air could be carried on at greater depths and under higher pressures than has hitherto been attempted, so that should the occasion demand it, engineering operations of even greater dimensions could be undertaken and carried to a successful issue, from the point of view of the health and safety of the workers. It is a question of close attention to minute details, and of these the most important are a plentiful supply of pure air and slow decompression.

DISCUSSION.

Mr. E. W. Moir said the paper had interested him exceedingly, as he had been conducting compressed air operations ever since the old Forth Bridge days, and, as a matter of fact, he had built some of the caissons which had been shown on the screen. One of the Forth Bridge caissons did sink suddenly, but the men in it had the presence of mind to put their hands over their faces, and so kept themselves from being smothered; and one of them, who happened to be in the shaft, signalled to the engine-room at once that something had happened, with the result that the whole caisson was lifted up, and the men escaped. So the danger from the sinking of a caisson was very real, and in soft mud in tidal rivers, where the buoyancy varied very much between high and low tide, it was sometimes very difficult to control it. He had had several instances showing that CO_2 played a very important part in this illness. Carbonic acid generally was not unwholesome, even in large quantities, in mining operations or where the atmospheric pressure varied very little; but in caisson chambers, where the pressure was greater, it seemed to have a markedly increased effect. At Blackwall the air was analysed from the very start, even before they had the medical officer on the ground. Prior to that he had some experience in the tunnel under the Hudson River at New York, where they had six men die in six months from caisson diseases alone. The original promoters of the Hudson Tunnel were very hard up for money, and so they worked the engines as slowly as they could, in order to reduce the coal consumption, and no attempt was made to look after the air or the effects on the men. If a man died there was no coroner's inquest, and it simply meant that another man recently imported took his place. They found that the deaths were fewer when they were working faster. He then instituted a recompression chamber. He thought that it was an original idea of his own when he had the chamber built, but it turned out that the scheme had been suggested in a less complete form by Dr. Smith, an American physician. This re-immersion chamber, or re-compression lock, worked with marked success, and reduced the death-rate from 25 per cent. to only a few per cent. They used to carry the men into the lock, put them under the pressure roughly that they had come out of, or a little less, then slowly decompress them, and bring them out in from 25 to 35 minutes. In nearly all cases, if they were put under pressure immediately, they went away rejoicing in a very short time. At the Blackwall Tunnel at one time when they were in open gravel and the air was rushing out as fast as they were pumping it in, the pressure was only 15 lbs. above the atmosphere, but some of their oldest hands who had been used to compressed air for many years, began to have pains in the knees. The air was examined, with the result that they found that instead of their standard of less than one part of carbonic acid in a thousand, they had suddenly run up to three parts. They were then passing under the old Blackwall sewer, which had not been cleaned out for 30 years, and was constructed of very bad brickwork, and so, doubtless, a large amount of carbonic acid had exuded out of the earth when they drove the tunnel through it. In New York, quite recently, they had had a very unpleasant reminder of the point Dr. Oliver had raised about the oil. They had a great deal of trouble in New York with a pressure of 36 lbs., and in the last six months they had lost eight men, besides having had a great many cases which had been cured in the medical lock, including some severe cases of men who had been in a comatose state for six or seven hours. They suddenly found that they were getting smoke in all the tunnels. Though they supposed they were buying a very high flash oil, they found they were not getting what they bargained for, and that the oil was smoky at a lower point than its flash point, the consequence being that they were pumping smoky air into the tunnels. As soon as that was found out, they went for the highest flash oil they could get, and since that date there had been a vast improvement in the condition of the men. If there was anything in the shape of impurity, whether it be CO_2 or volatile gases from the lubricating oils, or marsh gas from the coal, the ill effects were very much increased. A medical friend once told him of some experiments on guinea pigs and other small animals, who were placed in air containing a very large proportion of carbonic oxide under pressure. While under pressure, the small animals ran about and were quite frisky and happy, but on bringing them out they in many cases succumbed. Animals could live for many months in compressed air without ill effects. At the old Hudson Tunnel they had mules who were under pressure for more than twelve months. All that time they were perfectly happy and very frisky. They worked eight-hour shifts, and in their off-time if one walked along near them they would turn round and try to kick him. After about twelve months, when going to bring them out, they gave them each a bottle of whisky, and put mustard plasters over some of their vital

organs, which it was thought might be affected, and then brought them out very very slowly, taking half a day in some cases, and sold them for excellent prices. Therefore immersion did not do any harm for a great length of time while under pressure and if very slow decompression was resorted to, though, no doubt, it had the effect which was probably due, as Dr. Oliver said, to the absorption of gas in the blood, upon the men who, as a rule, came out too quickly. It had been proved pretty generally that the gas usually found in the blood in these cases was nitrogen, and, therefore, it had been concluded by some people that carbonic acid had nothing whatever to do with it. Nature had provided for getting rid of carbonic acid in the ordinary course of events, while it had not provided for getting rid of nitrogen with the same efficiency. The possibility was that the blood might absorb both, but that it got rid of the carbonic acid before the experimentalist had time to search for it, and then only the nitrogen bubbles remained. In another instance, as further evidence of the effect of CO_2, at the Blackwall Tunnel, where they had to explode cartridges in front of the shield in order to get a movement in the gravel, which was very dense, they had several cases where the men were attacked in one particular part of the shield. Samples of air were taken, and it was proved that they had gone beyond the health limmit with their carbonic acid in that particular place, no doubt due to the combustion of the explosive. At Dover Harbour, where they were using some very deep diving in bells (going down to 72 feet), they had never had a case, and it was very rarely that they had a case at the Forth Bridge. In a wet tunnel or a wet heading, the old miner always knew that the air was more pure than it was in a dry one; he thought that was accounted for by the fact that water itself under pressure absorbs a good deal of carbonic acid and possibly other gases which are noxious such as ammonia. He was glad to say that now there was no caisson job and no compressed air tunnel work anywhere which was not provided with a medical lock. At their present work in New York they had three on each side of the river, and they produced very good results; but he had had cases of men who had died, although every effort had been made to treat them in the medical lock and by all other known means. They had managed to change the oil he had spoken of on all the engines serving the tunnels but one; but it was impossible to change it at the particular engine which served that tunnel, because the lubricators were not delivered in time; and the last man who had died was at work in that tunnel and died of œdema of the lungs. Since they had got the new oil, their cases were remarkably reduced. Their pressure was high and had been up to 36 lbs. above the atmosphere, at which pressure the men only work 3 hours on, 3 hours off, and 3 hours on, making 6 hours in 24, exclusive of entering and leaving the compressed-air chamber at pressures below 32 they work for $7\frac{1}{4}$ hours in 24, making 3 shifts in 24 hours. All their men were medically examined, and they had a staff of medical officers on duty throughout the 24 hours. There was a great deal to learn about this subject, and Dr. Oliver's paper was the most detailed account of it, and contained the most likely suggestions of any he had ever heard.

Mr. Francis Fox said that though Mr. Moir might not have been the originator of the idea of re-compression, still he was the one who introduced it practically. Men working with compressed air, were working under conditions very much like those existing in a bottle of soda water before the cork is taken out. Dr. Oliver referred to that, and he (Mr. Fox) made use of the same simile some ten years ago. In drawing a cork out of a bottle slowly, the gas that is imprisoned in the water rises in very small globules, whereas if the cork were taken out rapidly, the gas came out in large bubbles, and the material overflowed on to the floor. In compressed air work, the air was forced right into all the tissues and the blood, and if the men were decompressed slowly, the air, he thought, was given off in very small globules, whereas if they were decompressed suddenly, it came off in large bubbles, and coagulation set in. He did not wonder at men wishing to get out of an air-lock in a hurry. Those who had had experience of it, knew that as soon as the pressure began to be lowered, they were immediately in a thick London fog with all its chilliness, and unless one wore extra clothing, or the place was warmed, one could not remain there long, particularly if standing. When he was at St. Louis they were using, he believed, the heaviest pressure that had been used up to that time, namely, $57\frac{1}{2}$ lbs. to the inch. They lost a large number of men, and that was attributed to their climbing up the ladders. Afterwards lifts were provided, and from that time onward there were very few cases of illness. He thought men under pressure should not be expected to climb ladders, as the muscular effort required was too great. Compressed air was looked upon as the last resource of an engineer; it was very costly, and it was risky, but it enabled them to carry out work which otherwise would be absolutely impossible. It was a little more than 50 years ago since caissons were first used. They were originally suggested by a Dr. Potts, but people did not think they could be used until his late father, Sir Charles Fox, had to construct the bridge at Rochester. Knowing the difficulties he had to contend with in the foundations of the old Roman bridge, through which a coffer dam would be most difficult and costly to construct, Sir Charles Fox decided to try the experiment of caissons. He believed that was the first time on which caissons were used, and he believed it was the first time also when compressed air was used. He had been very much struck by one of the

photographs showing the provision which was made by means of large girders for carrying the caisson when it suddenly sank into the bed of the river. At Rochester they got the cutting edge down on to the brickwork of the old Roman bridge, and it was loaded with kentledge to force it through; but when they took away the last piece of brickwork the thing went down with a run, and as nearly as possible jammed the men between the bed of the river and the top of the caisson. By so doing it also compressed the air. What the pressure was that those men were under nobody knew, but the pressure was so great as to hold the caisson up, and the consequence was that the men were not crushed, although they might have been.

The CHAIRMAN said that of late years there had been some alteration of opinion as to the amount of carbonic acid that the ordinary individual could support comfortably. He thought the point arose when what was known as the Twopenny Tube was first opened. After it had been opened for a certain time, some medical men discovered that the amount of carbonic acid in the air of the tube was such that the ordinary users of the tube ought to suffer very great inconvenience from it, if it did not have a serious and lasting effect on them. However, it was proved that it had no deleterious effect on the health of the people who were using the tube every day, though of course the quantities there were very much less than the quantities which had been spoken about that evening. He would like to hear more about the effect of oil smoke. Seeing what was going on now in the London streets, and the amount of smoke that people were unwillingly taking into their lungs from the new means of conveyance, it would be a gain if people knew something more about the effect of lubricating oil smoke, and whether it was as likely to be as deleterious at atmospheric pressure as it was under the heavier pressure in the caissons. Another point was that, judging from the figures alone, there ought to be a very serious draught in a caisson, when they were supplying something more than 12,000 or 13,000 feet of air per man per hour. Would that have any effect on men who were working hard, and who would be likely, he should have thought, to take cold?

Dr. OLIVER, in reply, said it had been extremely valuable to him to have the opinions of such practical engineers as Mr. Moir and Mr. Fox, who, he knew, had both worked at the subject, and, therefore, could deal with it in a manner altogether different from what he could pretend to. He could only deal with the question from the medical side. He was quite of Mr. Moir's opinion with regard to carbonic acid. There was, however, nothing so complicated as this question of compressed air illness. As cases occurred when the pressure was low, it was clearly not always a question of high or low pressure. Cases occurred very frequently when there was impure air; most of the serious cases in Newcastle occurred when the men were excavating soil impregnated with gases—that clearly indicated that the illness had something to do with the presence of carbonic acid. He was, therefore, not prepared to throw aside altogether the theory of impure air; as he had said, he thought impure air diminished the resistance of the men. As for the smoke from the lubricant used, with the smoke itself there were probably carbon dioxide, and it might be other gases, acccording to the oil that was used. Apart from their disagreeable odour, these gases were extremely poisonous. They acted by producing a sense of increased tiredness, which meant a loss of resiliency, and made a man unable in the ordinary time that was given to the de-compression, to get rid of the gases so effectively as a healthy man could in the same time. The effect of gas was a very interesting question. Although oxygen, for instance, was essential to life, yet if they exposed animals to pure oxygen, they would find that the animals became convulsed in the air chamber and died convulsed; or, if the exposure had not been too long and the pressure too great, the animals would die some days afterwards, and then it would be found that there were signs of inflammation in the lungs. Oxygen had acted as a poison to the system, and had set up inflammation of the lungs. The safe limit to work depended not altogether on the depth, but on the amount of atmospheric pressure, and after a certain limit, they would find that the oxygen itself became a source of danger. Recently he had been trying the effects of carbonic acid in ordinary air, by exposing animals to four atmospheres with 1 per cent. of CO_2. These animals came out of the de-compressing chamber perfectly well—they ran about, and there was apparently nothing wrong with them; but a few days afterwards they were found dead in the hutches. One of his animals lived for a fortnight and appeared to be quite well, but one day it was found dead. At the *post-mortem* examination, evidences of acute inflammation, and of the rupture of several small vessels in the lungs were found, showing that there had been something akin to what Mr. Moir spoke of, namely, acute œdema of the lungs. No doubt nitrogen was the gas that was most largely present, but that was simply because it formed 80 per cent. of the atmosphere, whereas CO_2 formed only ·04 per cent. That of itself explained the large quantity of nitrogen found. He was very much obliged to Mr. Fox for the suggestion that the men coming off work should not have to ascend the ladder. He had noticed that when they took the animals out of the decompression chamber and did not encourage them to run about much, they generally got well; but if the animals were very vigorous after they came out, very often they soon had a convulsion or two and died. He thought, therefore, that fatigue was an element to be considered. In support of what Mr.

Fox had said on that point, he would mention one fact. The men who were inside the caisson, and who worked the sliding floor through which the buckets were passed into the material, were exposed for the same number of hours to the same pressure as the men who were working down below; but they were doing practically nothing, and there never had been a case of compressed air illness among those men, although they were exposed to the same pressure as the others. He thought, therefore, that, in addition to the CO_2 and the rapid decompression, this element of muscular fatigue ought to be considered.

The CHAIRMAN, in proposing a hearty vote of thanks to the reader of the paper, said Dr. Oliver had added to their knowledge ot this subject, and shown how intelligent and systematic observation and experiment could render what must necessarily be a more or less dangerous occupation less dangerous in its after effects upon those employed in it.

The resolution of thanks was passed unanimously.

THE WOODS OF NORTHERN JAPAN.

The whole of the island of Hokkaido, the northernmost of the islands of Japan, was formerly, and to a great extent still is, covered with valuable forests; but, notwithstanding this, nothing was done to exploit these forests until about ten years ago, when a demand arose in China for railway sleepers, and in a few years there was seen the curious spectacle of huge oak trees, ash, maple, and other hard-wood trees, all valuable, being cut down and turned into railway sleepers and firewood. How much valuable timber has been, and is still being, wasted for this purpose it is impossible to compute, but the value of the sleepers exported from the island of Hokkaido during 1904 amounted to over £200,000. During the last two or three years, however, a reaction has set in against using the more valuable timber for this purpose. It is being realised that there are other markets for the same, and this, together with the rise in prices, as the cutting of timber is become more remote from the railways that transport it to the seaports, will no doubt, in course of time, raise the price to a figure that it will no longer pay to use the better kind of timber for such purposes as railway sleepers. According to the American Consul-General at Yokohama, the principal timber on the island at present is, and always will be, oak. The trees grow to a large size, but on account of the nature of the ground it is difficult to get out large pieces. The usual sizes are from 12 to 55 inches square, and from 8 to 30 feet long. It is of excellent quality. The next wood in importance is ash, of which there are about twelve different varieties, and two of which are specially sought for at the present time—one called by the Japanese "tamomoku," a beautiful kind of curly ash, and another called "tamo chichimi," which has a wavy grain, both are now used by carriage builders in Japan for panels, &c. There are some ten varieties of maple, one of which is a beautiful bird's-eye maple known as "itaya-moku," and another with a flowery grain known as "hana-itaya." Following the maples in importance is a wood called "sen," which is largely shipped to Tokyo and other ports in Southern Japan, where it is used in making furniture, for which it is very well adapted, as it gives a good polish, does not warp, and is quite hard and lasts well. This wood and the ash before mentioned come in larger logs than any other on the island, running up to 48 inches in square logs. "Katsura" is a species of cedar, of which there are several kinds, one of which, red "katsura," is stated to be well adapted to the making of cigar boxes.

PRIZES OF THE SOCIETY OF DYERS.

The Council of the Society of Dyers and Colourists announce that funds have been placed at their disposal for distribution in the form of prizes for the solution of technical problems. The following is the list of problems and prizes:—1. Prize of £20 for a full investigation of the average degree of tendering brought about in cotton yarn of various qualities by—(*a*) cross dyeing with acid colours; and (*b*) dyeing aniline black, with the object of fixing standards for the trade; 2. Prize of £10 for a practical method of so treating or preparing cotton yarn as to cause it to resist direct dyeing cotton colours [the object desired is the production of a pattern or mixed effect in the piece dyeing of all cotton goods]; 3. Prize of £10 for a practical method of dyeing full shades of basic colours on cotton, fast to rubbing; 4. Prize of £10 for a practical method of causing kemps, when present in yarn or piece goods, to take the dyestuff equally with the accompanying wool; 5. Prize of £20 for a full investigation of the mordanting properties of various tannin materials, more especially—(*a*) as to the relative affinity for cotton of the tannins of galls, myrabolams, sumach, divi-divi, &c.; (*b*) as to the relative fastness of the colour lakes produced with these tannins and basic colours, in conjunction with antimony, tin, and iron; (*c*) as to the best method of determining by volumetric analysis, or other means, their relative mordanting power; 6. Prize of £20 for a cheap and practicable method of producing a good black on tussur silk; 7. Prize of £50 for a practical method of so treating with some non-deliquescent substance, cotton pieces goods dyed logwood black and heavily filled, as to render them mildew proof in tropical climates without impairing either colour or finish. The prizes are open to all, irrespective of nationality. Papers will be accepted in English, French, or German. All papers, &c., sent in for competition must be delivered free to the Honorary Secretary of the Society on or before December 31st, 1906. Competitors can obtain further information on application to the Hon. Secretary of the Society, 10, Merton-road, Bradford.

ARTS AND CRAFTS.

Leather Bookbinding.—Leather bookbinding and gilt tooling used to be almost exclusively a trade: to-day it is perhaps the craft above all others which is practised by the amateur, the quasi-amateur, and the artist-craftsman. Who would have dreamed when Mr. Cobden-Sanderson started his bindery some twenty years or more ago, of the change of conditions which was to follow in its wake. And this change is not confined to the conditions of the trade; it has had a very great effect on, or at the very least has gone hand in hand with, an almost equally great alteration in the style of binding. To begin with, whereas in days gone by the backs of the books were always rounded, they are to-day rigorously and severely flat. These flat backs are often more pleasing to look at, but they do not wear well and the practical mind sometimes wonders whether, after many years of use, the front edges will still be pleasant to behold. A still greater change has taken place in the leather in which the books are bound. Owing largely, no doubt, to the Society of Arts' report, and the realisation of the perishable nature of much of the leather that was being used, ordinary morocco and calf are now very often replaced by niger leather, whilst treed calf is almost a thing of the past. Again, the ornamentation even on less sumptuously bound books is now almost always tooled, and marbled edges have had to make way for gilding or plain colours. Elaborately-tooled covers are, of course, still designed and executed both by the old firms and the newer craftsmen, but there is a great deal of very simple leather binding being done in the way of covers which are merely lettered, or on which the design is a simple diaper or a sprig, repeated either more or less haphazard or on more formal geometric lines, and this work is absolutely different from the simple binding of twenty years ago. Its simplicity may be sometimes rather affected. Its price is often high enough to make the would-be purchaser pause—a great deal higher than that of simple trade binding—but within certain confined limits it is tasteful, and it was some time ago original. The astonishing thing is that it is not more individual. Bookbinder's tools, as we all know, do impose very severe restrictions on the designer, but it is rather astonishing that these very limitations should not have called forth a corresponding energy and originality, especially in days like the present, when people are as a rule extraordinarily keen on getting value for their money. As it is the, old binders seem to have been able to produce with fewer tools more effective designs than are generally presented to us to-day.

Cloth Bindings.—If there has been of late a change in the style of leather binding, that change is still more marked in the place of cloth covers and paper wrappers. The difference in the wrappers of sixpenny novels and such like is so largely due to the development of photographic processes and the consequent possibility of producing cheap picture covers, that it requires but slight notice. With cloth cases, however, the matter is different, and the change marks a difference of taste and aim. In the first place, blind stamping, which was once the device *par excellence* for ornamenting a cloth cover, has almost disappeared, and the gilt stamping which characterised the binding of more ambitious books is now rarely met with except on the backs of the volumes. Indeed the whole tendency is to shift the ornament from the sides to the back. It is now no uncommon thing to see a volume with an elaborately ornamented back quite devoid of decoration on the sides. This leads, it must be owned, to a certain want of unity in the general appearance of the cover, but it is in part, at least, compensated by the suggestion it affords, that the book is meant to be put in a bookshelf and not merely left to adorn the drawing-room table. Another difference is in the cloth itself, which is now usually absolutely smooth. There are not, at present, if I am not mistaken, more than two large firms of publishers who still case a fair proportion of their books in the once common finely-grained cloth (not in imitation of leather). The modern "art linen," as they call it, has much to commend it, it is made in many shades, and some of them are far prettier than anything which was to be had some years back, but for hard wear, it is to be doubted whether any of the more modern fabrics surpass that same grained cloth which we are beginning to consider rather old-fashioned looking. Printing on cloth covers in coloured inks is another fairly recent device, and in some cases a very happy one. The effect of brown, dark blue and green inks on various coloured linen grounds is often extremely happy, and makes possible a style of cover design which could not have been executed with any success ten or fifteen years ago. The effect of white and very pale inks on a dark ground is often happy enough if a little uncertain, but it is uncertain. So much depends on the exact quantity of colour employed, that, in one batch of covers, effects of very varying degrees of success are obtained. If the white ink is heavily printed the cover has often a smudgy effect, and if, on the contrary, the printing is too light, the ground colour grins through in an unpleasant fashion. A really good cover design in light on dark would be extremely effective if it could be successfully carried out in a whole edition: but it is one of those things which are still to be achieved.

Cloisonné Glass.—One of the most interesting of quite modern glass processes is that known as "cloisonné glass." Its title tells, in a measure, the nature of the work, but not quite sufficiently to give a very clear idea of the method of manufacture or of the purposes to which it is appropriate. It is not a wall decoration, but a kind of substitute for stained

glass, very different in effect and in quality from any of the paper imitations of that substance. Cloisonné glass is genuine glass, as a rapid sketch of how it is made will show. A sheet of plain glass is put over the drawing to be executed, and on this the outlines of the design are traced in wire (black, silver, or gilt, as the case may be). These wire outlines, which are semi-circular in section, are firmly fixed to the background sheet, and into the cells formed by the cloisons are shovelled countless little glass beads or pieces of crushed glass, according to the effect desired. The whole surface is covered with these little beads, which are firmly cemented on to the ground, and the entire panel is then covered with a second sheet of glass. The great point of the invention is that, along with a pleasant variety of surface (the beads may be of various sizes, and, of course, in any case, do not give a perefctly plain surface), it is possible and easy to get an almost limitless variety of colour, as well as the most delicate and gradual shading, in which one colour melts almost imperceptibly into another. To begin with the beads are made in 800 colours, and (though this does not seem often to be done) a still greater range of effect could be produced by the use of several colours or tints judiciously and tastefully mixed together. Both the process and the effect are most interesting, and the practical utility of the invention is shown by the various uses to which it is put. The glass is used mainly for doors and windows, but it is perhaps seen quite at its best in the panels of lanterns and hall lamps, where the strong light immediately behind the broken surface gives sometimes a quite striking effect of colour. On table tops and trays it is seen to less advantage. All kinds of patterns are attempted, from the simplest designs after the manner of plain glazing to landscapes, flower pieces, and figure subjects. In these last the absence of lead lines comes as rather a shock, though the plan which is sometimes adopted of making imitation leads of crushed glass is by no means to be commended. Still, putting prejudice aside, there seems no valid reason why elaborate work should not be attempted in such a process as this, and some of it is certainly successful. The one point which does not satisfy the sense of fitness is the cementing of the beads on to the glass. It would be interesting to see the result of an effort to fuse them on without the aid of any other fixative than a glass flux. It is always rather unsatisfactory to stick things on to a flat surface by means of cement, shellac, or any medium not more or less allied to the parts to be united. We learn that small advertisement pictures made in this cloisonné class are beginning to be used in some of the motor omnibuses. They will certainly be much pleasanter to look at than the "glacier" paper bills which we accustomed to in the old horse omnibuses. If the glass stands the jolting it is likely to meet with on the motors, there is little fear of its failing to stand any hard wear that could legitimately be demanded of it.

CORRESPONDENCE.

BRITISH HONDURAS.

Reading the report of the paper read by Sir Neville Lubbock, K.C.M.G., before the meeting of our Society on March 6th last, entitled "Imperial Questions in the West Indies," and published in No. 2783 of our *Journal*, one thing struck me, viz.: Why is it that the poor little colony of British Honduras is always overlooked? Sir Neville mentioned British Guiana as being generally associated with the West Indies though on the main coast of South America. British Honduras, on the main coast of Central America, is just as much entitled to being associated with the West Indies, and, as a matter of fact, in the mind of nine Englishmen out of ten it is part and parcel of the West Indies. Why, then, when great men speak of great things, should this colony be passed over. Has it no merits of its own, or is it not worth mentioning? True, it is small enough, but I suggest that for loyalty, the small cost of it to the mother country, and large amount of profit it has brought and is bringing to the mother country (in trade) in proportion to its size and population, there is hardly any other that can stand alongside of it. But British Honduras has been, for ages, the cinderella of the colonies, whilst it should be, and would be, a shining ornament, if one-tenth of the attention was given to it, that is lavished upon others. Other colonies have been helped with Imperial money. British Honduras has always had to fight its own battles—nay, often it has had to pay for services of experts, railroad surveyors, and the blunders of incapable governors, sent out by the Home Government,—hardly in the interior of the colony. I do not blame any particular party government, all have treated and sinned against British Honduras alike.

When I arrived in the colony in the seventies, and after I had made myself acquainted a bit with the out-districts, I wrote home:—This is one of the most beautiful and fertile spots on God's earth, what is wanted are roads. With others, I have striven since then to bring about an amelioration in this respect, but to-day we still want roads. As it is, only the fringe of the colony along the sea coast and the river banks, to some little extent, may be utilised for any purpose whatever, the large areas of fertile and healthy backlands might as well be located on the moon. There is room enough for many plantations on a large scale, for the production of rubber, sisal, camphor, ramie, and other profitable things for which the climate of the colony is peculiarly well suited, but how to get to the lands and how to get the produce out? Ballooning is not far enough advanced yet! A look at the map will show that means of communi-

cation to the west would open up immense possibilities of trade with the frontier districts both of Guatemala and Mexico, as the route *viâ* Belize is the natural and shortest one.

Now, what is required to bring the colony into line and allow it to progress as it should and not to stagnate as it has done for the last 25, and as well the last 100 years? Nothing but roads, preferably railroads. One to the west, one to the north, and one to the south of Belize, the first one tapping the frontier districts of Guatemala and Mexico, the other one connecting with the Mexican system and tapping that newly conquered Indian territory and the last one going in a slanting direction, opening up the fertile backlands to the south of Belize, in the colony itself. But there is another very important thing. Belize has the only good harbour for a long distance on the Central American coast, it is thus the natural distributing point for a long coast range, and many islands, besides the colony's own hinterland. But to gain the profit which a *de facto* distributing point for all sorts of merchandise should bring it would be necessary to make it, and with it the whole colony, a freeport. Of course that would mean raising the necessary means to keep the Government machinery going, in some other way than heretofore (by import duties mainly). I believe, however, that there would be no unsurmountable obstacles in the way of managing that. The possibilities that lie in this idea are quite incalculable.

If the Home Government will allow those railroads to be built, and if necessary guarantee the loans, and will work out the idea of a free port, the colony will in a short time become a most successful and prosperous one both as regards agriculture and trade, and the Mother Country—in the shape of trade-profit—will earn tenfold what it may have to advance in the first instance.

But Honduras is too little known in the old country—why I don't know. Americans are smarter to see the openings it affords. An American syndicate is exploiting the vast pine forests of the colony for turpentine, another American syndicate has bought the large "Commerce Bight Estate"; several American concerns are almost monopolising the wood industry, and of course the first industry is firmly, if not fondly wedded to the "United Fruit Company," for better or for worse, mainly the latter.

If these lines will serve the purpose of bringing a little more prominently before Englishmen a colony of their own, wherein untold wealth awaits the plucky, a colony which I fondly call my home, though for reasons of family affairs I am temporarily an absentee, and cause a little more attention to be given to its affairs both by private individuals and the Government, I shall be most happy.

H. E. Oswald.

Darmstadt. May, 1906.

OBITUARY.

George Whight.—Mr. Whight, who died on April 7th last, was a very old member of the Society of Arts, as he was elected in 1866. He was born at Ipswich in 1829. He began life by joining his father's business—that of a builder From 1856 to 1859 he was in Canada, and in the latter year he returned to England, bringing with him the patent for a sewing-machine light enough to be worked by a woman. This machine, the "Whight and Mann Excelsior," he made at the Gipping Works, Ipswich.

In 1880 he brought from America a patent for a a mechanical musical instrument. Mr. Whight saw that there was a future for such instruments, though no one had at that time dreamed of their possible development, and became sole licensee for England.

As time went on, æolians, orchestrelles, and pianolas came to be in great demand, and the business became an assured success. The English music publishers then complained that the perforated music rolls were an infringement of copyright, and threatened to prohibit their production. Mr. Whight offered to pay a royalty, though he was legally protected by the Bern Convention, which classed these instruments as musical boxes. They refused this offer and took the case into the courts. In 1899 the important case of Boosey v. Whight was tried. The question at issue was whether copyright music could lawfully be played upon mechanical instruments such as the æolian, pianola, and the like. Mr. Justice Stirling took six weeks before giving his judgment, and then decided in Mr. Whight's favour. Messrs. Boosey carried the case to the Court of Appeal, when judgment was again given in Mr. Whight's favour. In the meantime the copyright question was under discussion by a select committee in the House of Lords. It was held that any intra-territorial interference with mechanical musical instruments would create a conflict with the international law as contained in the protocol to the Bern Convention. Lord Thring is reported to have said:—

"The action arose in this way. I will take a complete case rather than argue it an abstract form. Boosey the publisher has a copyright song. The Æolian people go and buy a copy of this song and transcribe in into a sort of hieroglyphic shorthand which the instrument can understand and nobody else can, and I venture to put it to your Lordships that ought not to be interfered with."

In September, 1899, when the law case was over, Mr. Whight sold his business together with the patent rights in regard to æolians and pianolas, and after travelling a little settled in Highgate. In December, 1903, he had an attack of cerebral hæmorrhage but partially recovered and for two years was a cheerful and patient invalid. He had never married and had no relatives. He died on April 7th, 1906.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MAY 16.—"The Development of Watermarking in Hand-made and Machine-made Papers." By CLAYTON BEADLE. SIR FRANCIS HAYDN GREEN, BART., will preside.

MAY 23.—"The General Supply of Electricity for Power and other Purposes." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E. SIR WILLIAM H. PREECE, K.C.B., F.R.S., in the chair.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 24.—MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.B.M.'s Consul-General and Agent to the Government of India at Khorasan, "The Parsis of Persia." THE RIGHT HON. LORD CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock:—

MAY 29.—"Glass Cutting." By HARRY POWELL.

*** This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

LECTURE I.—MAY 14. — Introduction — What Heraldry is—Symbolism—The common-sense basis of heraldic design—On asking why?—*The Shield*—Its structure—Evolution of decorative forms—The bearings on the shield—Ordinaries and charges—Heraldic animals — Distinctive poses — Distribution and proportion—Adaptation of heraldic poses to the occupied space. The expression of essential qualities.

LECTURE II.—MAY 21. — Imaginary animals—Unicorns—Griffins—Dragons—Heraldic birds. *The Crest*—Its character and composition in tournament usage—Artistic treatment in representation—Tournament fashions in war—Difficult crests and how to treat them. *The Helm*—Its construction—Position and treatment in heraldic groups—The helmet or small helm—Its mechanism—As an indication of specific rank—Barred helms. *Mantling*—Its evolution from simple drapery—Its special value in heraldic composition — Colour treatment — Surface decoration — The torse.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George W. Eve, "Heraldry in Relation to the Applied Arts." (Lecture I.)

Medical, 11, Chandos-street, W., 8 p.m. Annual General Meeting.

TUESDAY, MAY 15...Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. Stirling, "Glands and their Products." (Lecture II.)

Statistical, in the Theatre of the United Service Institution, S.W., 5 p.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. 1. Mr. Jules L. F. Vogel, "The Electrolysis of Fused Zinc Chloride in Cells Heated Externally." 2. Mr. H. D. Law, "Sensitiveness of the Platinum Electrode."

Zoological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Professor Corbett, "Flower Gardens in the United States."

WEDNESDAY, MAY 16..SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Clayton Beadle, "The Development of Watermarking in Hand-made and Machine-made Papers."

Meteorological, 70, Victoria-street, S.W., 4½ p.m. 1. Dr. W. N. Shaw and Mr. G. C. Simpson, "An Instrument for Testing and Adjusting the Campbell-Stokes Sunshine Recorder." 2. Mr. R. G. K. Lempfert, "The Development and Progress of the Thunder Squall of February 8th, 1906."

Microscopical, 20, Hanover-square, W., 8 p.m.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. Annual Meeting.

THURSDAY, MAY 17...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 8½ p.m. 1. Messrs. E. C. C. Baly and W. B. Tuck, "The Relation between Absorption Spectra and Chemical Constitution." Part VI. "The Phenyl Hydrazones of Simple Aldehydes and Ketones." 2. Messrs. A. W. Crossley and J. S. Hills, "Aromatic Compounds Obtained from the Hydroaromatic Series." Part II. "The Action of Phosphorous Pentachloride on Trimethyldihydroresorcin." 3. Messrs. T. M. Lowry and E. H. Magson, "Studies of Dynamic Isomerism." Part V. "Isomeric Sulphonic-derivatives of Camphor." 4. Mr. W. A. Davis, "Studies on Basic Carbonates." Part I. "Magnesium Carbonates."

Royal Institution, Albermarle-street, W., 5 p.m. Rev. J. P. Mahaffy, "The Influence of Ptolemaic Egypt on Græco-Roman Civilisation."

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Messrs. R. H. Tweedy and H. Dudgeon, "Notes on Overhead Equipment of Tramways."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, MAY 18...Royal Institution, Albemarle-street, W., 9 p.m. Prof. Arthur Schuster, "International Science."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MAY 19...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Sir James Dewar, "The Old and the New Chemistry." (Lecture I.)

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FRIDAY, MAY 18, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 21, 8 p.m. (Cantor Lecture.) GEORGE W. EVE, "Heraldry, in Relation to the Applied Arts." (Lecture II.)

WEDNESDAY, MAY 23, 8 p.m. (Ordinary Meeting.) JAMES N. SHOOLBRED, B.A., M.Inst.C.E., "The General Supply of Electricity for Power and other Purposes."

THURSDAY, MAY 24, 4.30 p.m. (Indian Section.) MAJOR PERCY MOLESWORTH SYKES, C.M.G., H.B.M.'s Consul-General and Agent to the Government of India at Khorasan, "The Parsis of Persia."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 14th inst., Mr. GEORGE W. EVE delivered the first lecture of his course on "Heraldry in Relation to the Applied Arts."

The lectures will be published in the *Journal* during the autumn recess.

APPLIED ART SECTION.

The meeting of the Section on Tuesday evening, 29th inst., when Mr. HARRY POWELL will read a paper on "Glass Cutting," will be held at the Whitefriars Glass Works, Tudor-street, E.C., by the kind permission of Messrs. James Powell and Sons.

The accommodation is strictly limited, and 100 tickets only will be issued. These tickets have been issued in order of application to members. A few tickets still remain and should be applied for at once. Each member is entitled to apply for one ticket, which will be transferable.

No one can be admitted without a ticket.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 16th, 1906; SIR FRANCIS HAYDN GREEN, Bart., in the chair.

The following candidates were proposed for election as members of the Society:—

Brandt, Rev. L. E., Pietersburg, Transvaal, South Africa.

Cook, Samuel Edwin, 3 Recreation-road, Tientsin, North China.

Hackett, Hon. J. W., M.L.C., L.L.D., M.A., St. George's-terrace, Perth, West Australia.

Hellyer, Thomas Waterman, care of Messrs. Locke, Lancaster and Johnson, 94 Gracechurch-street, E.C.

Holmes, Frederic, Messrs. Hatton and Laws, Launceston, Tasmania.

Nash, Hon. John Brady, M.L.C., M.D., Macquarie-street, Sydney, New South Wales, Australia.

Parry, Frederick H., Sule Pagoda-road, Rangoon, Burma.

Taylor, John Eldred, Spilsbury-house, Wilberforce-street, Freetown, Sierra Leone, West Africa.

Venkataramayya, D., Kali Nidhi, Mallesvaram, Bangalore, India.

Wallace, H. Vincent, Sombreretillo Mine, Sasabe, *via* La Osa, Nogales, Arizona, U.S. America.

The following candidates were balloted for and duly elected members of the Society:—

Beale, Octavius Charles, Howard Hotel, Norfolk-street, Strand, W.C.

Liberman, H., Rosecourt, Breda-street, Cape Town, South Africa.

Mackrell, John, High Trees, Clapham-common, S.W.
Mole, Miss Mary, 49, Baker-street, W.
Parker, Charles E., Penketh-lodge, near Warrington.
Rose, Arthur Veel, 24 West 59th Street, New York City, U.S.A.
Takahashi, Korekiyo, The Bank of Japan (Nippon Ginko), Tokyo, Japan.
Williams, Henry Sylvester, 5, Essex-court, Temple, E.C.

The paper read was—

THE DEVELOPMENT OF WATER-MARKING IN HAND-MADE AND MACHINE-MADE PAPERS.

By Clayton Beadle.

Watermarking may be described as the act of imparting to paper a distinctive mark in the course of manufacture. This may be accepted as a general definition at any rate for the purpose of this paper, but inasmuch as the marks produced by the machine wire and the wire surface of the hand mould are of the same description as the distinctive marks, it might be claimed that these also are watermarks. In other words, it might be claimed that the "wiremark," as it is called, is as much a "watermark" as the watermark itself. In order that we may fully comprehend the nature of watermarking it is therefore necessary that we should consider both kinds of marks, as upon the nature of the wire upon which the watermark proper is built up, depends the nature and scope of the watermark itself.

Acting on the assumption that the majority of those whom I am addressing are unacquainted with the technicalities of paper-making, I shall occasionally refer to and explain certain paper-making processes, at least, in so far as they relate to the subject of watermarking.

From the time of its discovery to about 100 years ago all paper was made by hand, either by dipping a "mould," consisting of a sieve covered with network, into a vat containing water in which fibres are suspended, or by pouring the liquid pulp upon the sieve. The mass, after removal and drying, constituted crude paper. For about 2,000 years paper was so produced, but for the first 1,200 or 1,400 years no watermarks made their appearance. The first known mark bearing date 1301 A.D.

Although I have never heard any attempt to explain why it was that watermarks were not used in such early papers, I think it may possibly be attributed to the fact that the guaze or network which formed the surface of the sieve or mould originally consisted of vegetable fibres or stalks, to which, presumably, watermark designs could not have been attached, and that it was not possible until the introduction of metal wires to attach watermark designs. This point might be cleared up if we could ascertain the period at which a wire surface was first applied to hand-paper moulds. The watermark designs themselves have always been made of a wire, and could hardly have been made by twisting vegetable fibres; in fact they are practically the same now as when first introduced. Many people imagine that the introduction of watermarking was coincident with the discovery of paper. This is you see altogether a mistake.

The Laid Cover for Laid Paper.

On the introduction of metal wire for the surface of the paper mould, the woven wire gauze was unknown. The necessary surface was then got by placing pieces of wire parallel to one another. These were kept at a proper distance apart by thinner wires made to pass under and over the parallel wires and at right angles to them in such a way as to keep the laid wires at uniform distance apart, which distance is about equal to the thicknes of the wire itself. The impression, produced by these laid wires, is called the "laid" mark, and the cross or chain wires, the "chain" mark. In the samples before you, prepared by Messrs. T. J. Marshall and Co., you will see that the sizes vary; in the finest (1) we have 33 laid wires to the inch, and the chain wires are a little over 9-16th of an inch apart; (2) 23 laid wires to the inch, chain wires 15-16th of an inch apart; (3) 20 laid wires to the inch, chain wires 1 1-8th inch apart; (4) 19 to the inch, chain wires an inch apart; (5) 18 to the inch, chain wires 1 1-16th apart. These specimens serve to demonstrate to us the character of the surface which imparts to the paper, whether hand or machine-made, the laid and chain marks familiar to us all.

The construction of the hand mould is worthy of some remark. You will notice that the strengthening bars which, form the foundation for the "laid sheet" or "wove on cover" are wedge-shaped in section, and this wedge causes a suction from the top face of the mould, at the instant the mould is withdrawn from the vat. The wire backing which is now placed immediately underneath the face of the cover serves the double purpose of strengthen

ing its foundation and preventing the formation of the dark mark in the paper along the length of each chain wire formerly produced by contact with the bars. This dark mark is specially noticeable in old hand-made laid papers.

The Wire Device for Watermarking.

On to such "laid covers" is attached the wiremark, the fineness of which is dependant upon the diameter of the wire used for the purpose. The silvered wires now used for the lettering and devices of watermarks are prepared in 12 diameters, varying between 18-1000th to $32\frac{1}{2}$-1000th of an inch. These are dexterously twisted to the desired shape and design of the watermark. In hand-made papers these are attached to the wire surface of the mould by a very fine brass sewing wire, either 7-1000ths, $6\frac{1}{2}$-1000ths, and 5-1000ths of an inch, of which I show you samples. Such sewing-wire is too fine to leave an impression upon the paper.

Many of the watermarks of the fourteenth and fifteenth centuries bear evidence of a much coarser stitching wire having been used —wire perhaps as coarse as that constituting the wiremark itself. Midoux and Matton speak of the wire designs of this period having been stitched or soldered, but I am strongly of impression that all such marks were stitched only, and that these authors imagined marks to have been soldered when the paper bore no evidence of the stitching wires, and that it was for Marshall to introduce the method of soldering now in vogue for the watermarks of machine-made papers. To this day the wire devices have to be stitched on to hand moulds, the soldering process being found to be unsuitable for such purposes, except when the soldered-on devices and "cover" are afterwards electroplated with copper.

The Wove Wire Gauze for Wove Papers.

It was not till 1750 that John Baskerville, the famous Birmingham printer, introduced woven wire to obviate the roughness of laid paper; his beautiful edition of Virgil of 1757 is chiefly printed on this wove paper. Woven wire as a cover opened up fresh possibilities in watermarking hitherto undreamt of, which took at least 100 years from this date to come to maturity. The weaving of wires for paper machines and hand moulds is now a very large industry. They are made on special looms and the wire drawn through diamond dies to insure smoothness and regularity.

Dipping the Mould into the Vat.

When the vatman prepares his sheet, he dips his mould in the way that I show you, thus, into the vat of pulp, quickly raises it, and shakes it, when the water passes through, leaving a network of wet fibres on the surface. These, on settling down upon the wire, take the shape and contour of its surface, so that when the mass is subsequently removed it retains, as it were, a cast of the surface. When such paper, after drying, is held up to the light, the wire device is seen by reason of the fact that the paper is thinner where the wires have left their impression. Here the light more readily passes through than through the body of the paper. The watermark of a paper is rendered visible in consequence of the relative transparency between the mark and the background. It is a transparency effect. It is practically invisible when the paper is placed upon the table, in consequence of the light not being transmitted through it, but merely reflected from its surface. This fact is brought home to us when we consider that the majority of people who have used paper all their lives cannot tell you whether it is "laid" or "wove," or whether it bears a watermark or not, merely because they have never held it up to the light and looked through it.

The Difference between Watermarks on Hand and Machine-made Papers.

There is a vast difference between a watermark produced upon a hand-made and that produced upon a machine-made sheet. This difference is somewhat difficult to explain. A hand-made watermark can be made much superior to a machine-made one. Therein, I think, lies one advantage in favour of hand-made paper. With hand-made paper the mark begins to be formed from the very moment that the fibres are first deposited. Now, machine-made paper is produced by causing a flow of pulp to pass on to an endless band of wire gauze, which process will be fully demonstrated to you when Messrs. T. J. Marshall and Co.'s ingenious miniature paper machine is set in operation at the close of the paper. You will then see that most of the water has passed through, and the fibres have settled down to their relative positions before the watermarking process is applied by means of the "dandy"—a brass skeleton roll

with a laid or wove cover. Specimens of these "dandies" you see before you.

A roll of this description revolves upon the surface of the pulp, in doing so, it imparts to the surface of the pulp any designs or lettering attached to its surface, as well as the laid or wove marks.

Machine watermarking requires great skill on the part of the machine man. He has to ensure that the fibres are properly knitted together by controlling the shake of the machine, and by the control of the suction boxes has to ensure that the web of paper reaches the dandy with the right amount of water in it; too much or too little water spoiling the watermark. Moreover he has to control the shrinkage of the web so as to ensure that the watermarks come in their right position on the finished sheet. This may be assisted by causing the dandy to revolve at a slightly slower speed than the surface of the web. The machinist can also put a "draw" or "pull" upon the web and so prevent its natural contraction. With such questions as these, however, we need not now concern ourselves, as they can be fully explained when the machine is set going.

The "Grain" in Machine Watermarks.

The fibres of the wet web being in a very soft or mouldable condition, they are readily disturbed from their former positions by the dandy roll. I have recently established the fact that the small parallel-laid wires of the dandy make their impression by pushing away those fibres parallel with themselves, and leave those that are at right angles. Thus it is that the little ridges in between the laid marks consist largely of fibres running in their own direction, whilst in the laid marks the fibres run across the furrows. Hence it is that by disturbing the wet network of fibres after they have settled down upon the machine wire, the "grain" of the paper is altered in the case of the watermark of machine-made papers, and as we have already seen, it is left undisturbed in hand-made papers. I proved this point, on behalf of Messrs. George Newnes, Limited, by examining under the microscope thin films of fibres split from the surface of paper without disturbing their relative positions. The results of these tests, together with photo-micrographs in demonstration, were published in *Technics*. I measured the angle of the different fibres under the microscope, and found that the mean direction of fibres *between* the laid lines was parallel, whereas *on* the laid lines the fibres more frequently lie at right angles to this direction. This is evident even to the naked eye when shown in enlargement on the screen.

The Effects of Fibres and Beating.

Apart from the above considerations which are not without a considerable practical issue, there are others of importance in the technique of watermarking to which we will briefly refer. If it is desired to produce the best possible watermark effects, other qualities such as "rattle" and strength may have to be sacrificed. A clear and well-defined watermark is difficult to produce in a strong paper, as the long and coarse fibres tend to obliterate the sharp outlines. The result is more satisfactory when the fibres are well milled, beaten, and carefully screened.

Nearly all the early watermarked papers were made from rag. The best are still made from rag and by hand. Certain classes of rag lend themselves admirably to rich treatment. Chemical wood, which raw material constitutes our chief source of supplies in point of quantity, is under ordinary circumstances unsuitable for the display of fine watermarking. Paper-makers tell us that wood pulp does not take so kindly to the dandy, whereas esparto after the dandy has done its work "lays down," which is another way of saying that it takes the impression well, due largely to the fineness and pliability of the individual fibres.

The nearer we approach to a perfect watermark the nearer does the surface of the paper resemble a plaster cast of the wire surface on which it is produced.

Nature of Surface.

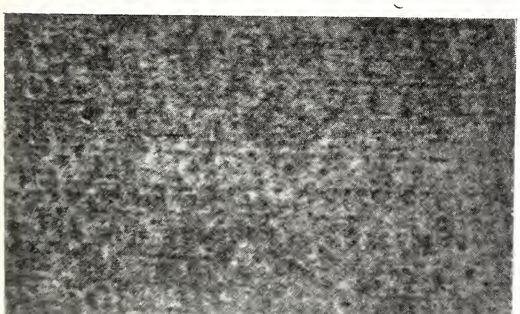
If we look very carefully at the surface of a laid paper under a microscope we shall find that it resembles that of a ploughed field, but that the furrows are somewhat rounded instead of being V shaped, due of course to the impression of the wires. The surface of a wove paper is of course somewhat more complex in detail but is of greater smoothness, the irregularities being less pronounced. Moreover, by the use of a very fine wire gauze the surface can be made very uniform, as can be seen on examination of the watermarked sheets before you. The watermark of a paper is not so visible when wet as when dry, and is best observed in the unglazed sheet. Glazing, rolling, and calendering make the watermark less visible, due to the fact that the pressure of these processes increases the transparency of the back-

ground bringing it nearer to the transparency of the watermark itself, so that in very heavily plate glazed papers the watermark becomes more or less blurred, when it is said to be crushed. It goes without saying that for fine effects in watermarking the material must not be too opaque. On the other hand, too great transparency would destroy the watermark effect by destroying contrast. The mark is rendered momentarily more visible by dipping sheets in alcohol. When these are allowed to dry in the air a stage is reached at which the alcohol from the thinner parts has evaporated showing a contrast against that which has not evaporated in the thicker portions. On further drying it resumes its normal appearance.

Taking Impressions of Watermarks.

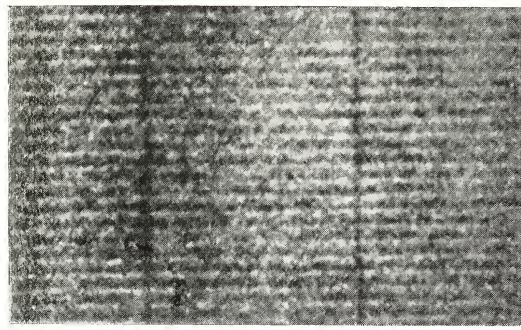
The crudest and quickest way of doing this is by placing sheets of tracing or other transparent paper over the watermarked paper, and tracing the outlines with pen and ink The process is rendered more easy by placing the sheets upon a glass plate with a looking-glass or other source of light below in such a way that the mark is seen by reflected light. In some such way as this the watermarks such as we find in books on the subject have been reproduced from old manu-

Fig. 1.



scripts. For the production of lantern slides thin sheets of glass $3\frac{1}{4}$ by $3\frac{1}{4}$ can be dipped in gelatine solution containing a little formalin. When dry this is traced upon with pen and ink as above, with the results as shown. But such crude methods do not show the real texture of the mark although they are sufficient as a record. A real facsimile can be produced by placing sensitised photographic paper under the watermarked paper and exposing in an ordinary printing frame, and finishing in the usual way. This method has been adopted by Dr. Paul Klemm for investigating the surface of papers, and to him I am indebted for permission to reproduce Fig. 1, surface of laid paper, and Fig. 2, surface showing "felt marks." These results are really negatives showing the more transparent portions appearing black and the opaque white. For lantern slides, plates may be substituted for sensitised

Fig. 2.



paper, with like or even more pleasing results. This opens up an important field of investigation into the surface of papers and the nature of their marks.

First Watermarking of Machine-made Papers.

J. Lines, a foreman in the employ of William Joynson and Son, whom I can just remember, I find on reference to old documents, is generally credited with being the first to watermark machine-made paper by sticking devices on the couch-roll by means of soap. Barrett, in the employ of the same firm, attempted, in 1830, to attach watermark designs to the machine wire. In an old MS. lent to me by Mr. Harry Donkin, Barrett shows an illustration of this. For practical purposes it is impossible to produce watermarks in this manner, although if it could be accomplished, the result would be much better than when the marks are attached to the dandy.

The Dandy Roll.

The report of the jurors of the Exhibition of 1851 states that Wilkes or Wilks (a partner in the firm of Bryan Donkin and Co.) invented the dandy roll, but Wilkes's roll was perfectly useless, and was not a dandy roll at all. His was made by cutting slots in a roll covered with thin sheet metal. John Marshall, the founder of the firm of T. J. Marshall and Co., invented the dandy, which was at first called a "riding roll." It was christened the dandy when a new spick and

span roll was brought into the works of William Joynson and Son, when some one exclaimed, "Isn't that a dandy?" The roll consists of a brass tube, on to which is fixed spindles at each end with holes for sewing on the laid cover. To the tube at regular intervals are fixed perforated discs or flanges. This cover is supported by long, thick backing wires, 1-10th inch in diameter, to which the wire gauze is attached. The diameter and length of dandy rolls vary according to requirements.

Cheque Papers.

Cheque papers, which we have occasion at times to test for the banks, are not dependent upon watermarking as a means of preventing forgery. The problem here is an entirely different one to that of the bank note. The great thing with a cheque paper is to provide against tampering and alterations on the face of the cheque. This in many banks is insured against by chemically and otherwise treating the paper, whilst in some banks no such precautions are thought necessary. The use of certain extremely sensitive inks is by many considered to be the best safeguard. I think it must be admitted that to publish information on such subjects would be against the general interests of the public.

Complexity of Old Moulds.

The complexity of paper moulds used at one time for the manufacture of Bank of England notes can be gathered by the following description given by Herring, which description, I presume, refers to moulds made by John Marshall in his official capacity at the Bank of England:—

> "In a pair of five-pound note moulds, prepared by the old process, there were eight curved borders, 16 figures, 168 large waves, and 240 letters which had all to be separately secured by the finest wire to the waved surface. There were 1,056 wires, 67,584 twists, and the same repetition where the slack wires were introduced to support the under surface."

Marshall's method of soldering the lettering on to the dandy roll in lieu of stitching, effects an enormous saving of labour. The same process cannot, however, be applied to hand moulds, unless the moulds afterwards receive an electro-deposit of copper.

The watermark in papers on which notorious forgeries have been perpetrated have on more than one notable occasion afforded means for their discovery. W. H. Ireland, in his "Confessions," describes how in forging the Shakesperian manuscripts, he contrived to introduce the watermark of the time of Queen Elizabeth by procuring from a bookseller the fly leaves of various old volumes in his possession. Having discovered that the pot mark was frequently used, he obtained and used papers with this mark, interspersed with plain sheets. Some forgers have been more clumsy, and have selected papers which, on examining for watermark, has been found to have been of a much later date than the supposed document. In this manner several forgeries have been brought to light.

Bank Notes.

The question of producing paper for such purposes was investigated by Lavoisier the well-known French chemist, at the time of the "Assignats." He studied the question of fibres for the purpose. A German authority recently expressed the opinion that the great guarantee against imitation lies in the fact that the Bank of France, the Banca d'Italia, and the Bank of England print their notes in their own factories, while other banks and Governments obtain them from large commercial houses with the highest reputations, such as Waterlow's, De la Rue's, and Bradbury, Wilkinson and Co., of London. He regards the English bank note as being the most difficult to forge. The French and Italian banks are dependant to a large extent on the paper of their notes, but they lay great stress upon the importance of the printing and special photo-chemical and other ingenious processes. The Russian Government have made improvements in regard to the paper for their notes, whereas the German bank notes appear to depend only on the printing as a guarantee against imitation. According to the above-mentioned authority German papermakers are unable to produce a really good shaded watermarked paper, which alone presents, in his opinion, real difficulties in attempts of imitation.

Now science comes to our aid in the shape of photo-mechanical and other processes. According to modern methods every gradation of light and shade can be produced. The various special watermarks manufactured by the firm of Catiere de Maslianico of Como are produced from moulds supplied by Messrs. Green, Son and Waite, Ltd., of London, to whom I am also indebted for other samples of shaded watermarks produced in their moulds, which I ask you to inspect closely.

Pietro Miliani, the well-known Italian firm of paper-makers at Fabriano, showed at the Paris Exhibition a number of papers in which coloured fibres were disposed in special positions so as to form figures and devices. I am indebted to this firm for a splendid selection of shaded and coloured watermarking specimens of which you will see before you. Here we have the display of real art, aided by the best scientific methods at our disposal, used in the production of watermarks, which would be next to impossible to imitate. Such papers as these, although largely made abroad, are produced on moulds manufactured by English firms.

Shaded Watermarking.

This is a special kind of watermarking, which lends itself to the most artistic treatment. The general principle of it is by no means new, for it was in vogue 50 or 60 years ago. Specimens of that period we have before us; one bound in Herring's book of 1855, bearing the watermark, W. H. Smith, to whom the world is largely indebted for producing moulds for this purpose, another of a landscape, but both are feeble attempts compared with the beautiful results now obtained. The process then employed was to make an electrotype of any model or design, forming a matrix or mould, which was mounted upon lead or gutta-percha, and pressed in contact with the wire gauze. The gauze, bearing the impression of the design, was then mounted as a cover upon the paper mould. Sometimes the design is engraved upon a plate and then transferred to the wire gauze. I am informed the photo mechanical processes cannot be used as they do not afford sufficient relief. Paper made upon such moulds varies in thickness in parts according to the depth of impression in the wire. With fine stuff every gradation of tone may be produced. A portrait of the Emperor Napoleon was so produced and exhibited at the Industrial Exhibition of Paris in 1849.

Mulready Envelopes.

Watermarking is not the only means of insuring against forgery, Mr. John Dickinson, the founder of the firm of John Dickinson and Co., devised a process for the introduction of cotton, flaxen or silken threads into the body of the paper, which, though first patented in 1829, was not brought to perfection until ten years later, when it again formed the subject of a patent. Mr. Lewis Evans tells us that on the introduction of the penny post about 1840, envelopes and flat sheets of note paper were sold by the Post-office to the public, and to prevent spurious imitations, paper was manufactured so that each paper contained in it two silk threads, one of pink and the other of twisted white and blue, and each sheet two threads, one blue and white, and the other pink and white. Exchequer bonds were printed on a thicker paper, in the body of which seven or eight threads of coloured silk were imbedded, the arrangement of the colours varying with each issue. The Mulready envelopes and covers, now much valued by collectors, were made of paper of the kind just mentioned.

The above can hardly be regarded as a process of watermarking, although coloured threads are disposed in papers in the form of designs by a species of watermarking in the manner of samples before us.

Coloured Watermarking.

Mr. Lee, of the firm of W. S. Hodgkinson and Co., of Hookey Hole, was, I believe, the first to produce coloured watermarks, at any rate he was the pioneer in this country. The samples I am able to show you, produced by Lee about 20 years ago, are very creditable productions. He patented his process in 1886. The bank notes his firm produced were made in two or more different coloured pulps combined in one sheet in such manner as to make them extremely difficult to imitate.

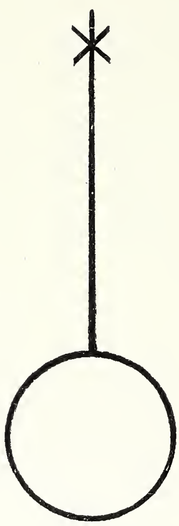
A process for introducing coloured watermarks into the body of a paper was patented by Messrs. Ant and G. B. Fornari, papermakers, of Fabriano, Italy, and is fully disclosed in their British patent, 1901. Each sheet is made in two layers, and between them is placed a third layer as a design in any colour. Sheets can, I believe, be so manufactured as to render the colour design only visible by reflected light. The design or lettering is produced by placing a stencil over the mould cut in the form of the lettering.

In my opinion, the work of the Italian firms Pietro Miliani, Cantiere de Maslianico, and such firms, is the finest and most artistic, and requires the most art and skill of anything produced in the shape of hand-made paper. I do not suppose for one moment that any such work could by any possibility be executed by mechanical means. To produce such work on any kind of paper machine is entirely out of the question.

Earliest Recorded Watermarks.

Sotheby states in his *Principia Typographica* (vol. 3, 1858, p. 10) that Jansen may be considered as the only author who has entered into the subject of watermarks with any degree of earnestness. Jansen records what is believed to be the earliest mark known. It occurs on paper in an account-book dated 1301, and consists of a circle or globe surmounted by a cross.

Fig. 3.



First known Watermark, 1301.

Among early watermarks varieties of this simple mark are very common in the fourteenth and fifteenth centuries. There are examples of double globes united by a line and ornamented by crosses.

Marks although common in the early part of the fourteenth century do not appear to have come into general use until about the middle or perhaps second quarter of the century.

The Rev. Joseph Hunter (*Archæologia*, xxxvii., 447) refers to a manuscript book of 1302, the paper of which has no mark. This appears to indicate that at the beginning of the century the marks were only just coming into use.

In a thin volume entitled "Papiers et Filigranes des Archives de Gênes, 1154 à 1700, par C. M. Briquet; avec 593 Dessins Autographiées. Genéve 1888" (roy 8°), the author gives the date 1154 as that of the commencement of watermarks, but there is no evidence of a mark at so early a date as this. In the chronology prefixed, we find this entry, "1154 à 1300, absence" [from the papers at Genoa], so that it is difficult to understand why 1154 is referred to at all.

In the 9th edition of the *Encyclopædia Britannica* it is said that in fourteenth century watermarks are usually simple in design, and being the result of the impress of thick wires, they are strongly marked. In the course of the fifteenth century the texture gradually became finer, and watermarks more elaborate.

Among the older watermarks there are a large number of animals of a strange character—the wivern, an imaginary animal, is one of these, but the usual heraldic representation of it is rather better than the watermark presentment in the fourteenth century as shown in the annexed figure.

Fig. 4.

The Parrot is another instance of a poor representation of a bird. (Fig. 5).

Fig. 5.

Parrot.

The Ram's Head (Fig. 6), is a frequent subject in early watermarks of the same character as those of the Ox's Head, as shown in Fig. 7.

Old German Watermarks.

I am indebted to Dr. H. P. Stevens for abstracting the literature on the subject of German marks; and also to Professor

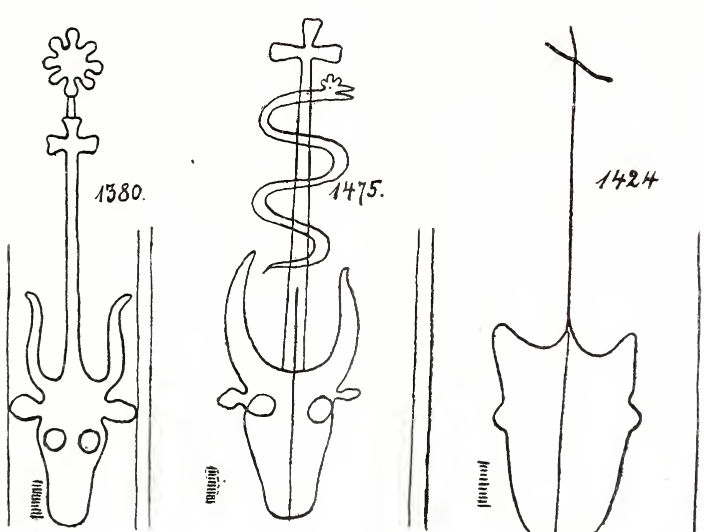
Fig. 6.

Ram's Head.

Kirchner, the author of "Das Papier," who has made a special study of the early marks in Saxony with a view of establishing their first introduction. Certain of these marks, among them a bridge with three turrets of 1544, two unicorns in shields of 1666, a rose in an escutcheon of 1540, a shield of 1516, a Waldenberger mark of 1500, a Stadt-Zwonitz mark of 1593, a Neider-Zwonitz mark of 1611, prove the existence of these paper mills at the above dates.

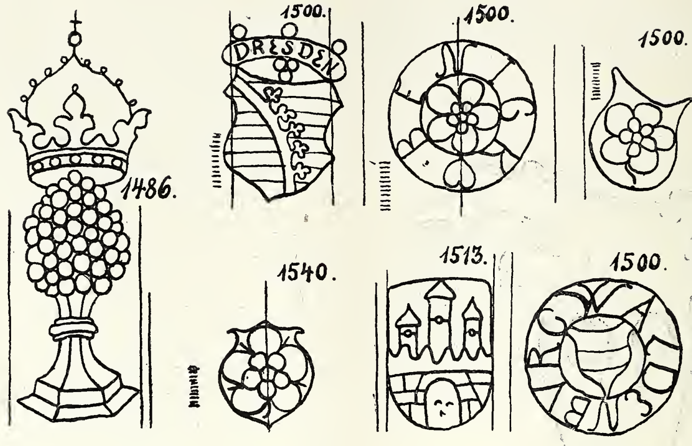
In the fourteenth century paper mills were at work in Ravensberg and Nurnberg. With a view of erecting a mill at Chemnitz, in Saxony, a concession was granted to the Abbé of the Benedictine Monastery for the right to erect a paper mill. This is contained in a document dated 10th March, 1398, in the State archives of Dresden, but there are no records of such a paper mill having been erected in any early histories or documents. Dr. R. Zöllner combatted this view on the grounds of the marks (Fig. 7) found in numerous documents of the archives of Chemnitz Town-hall, containing the head of an ox, surmounted by a cross with the serpent entwined round it. He thought this was evidence that the mills were in existence shortly after the promulgation of the above-mentioned concession, *i.e.*, in the fifteenth century. It proved, however, that these marks belonged to Italian papers made in the fifteenth century, made for the best kind of Italian writing papers between 1470 and 1530 on the Lago di Garda, which were copied down to the seventeenth century in papers made outside Italy. On Fig. 7 is the oldest genuine mark found in the town archives of Ravensberg, 1424 copied from the early Italian. I also give you the earliest Dresden, Augsberg, Penig, Freiberg, and Waldenberg, in Fig. 8.

Fig. 7.



Many of the early Saxon watermarks, consisting of arms or devices, have introduced into them the initials of the makers. One

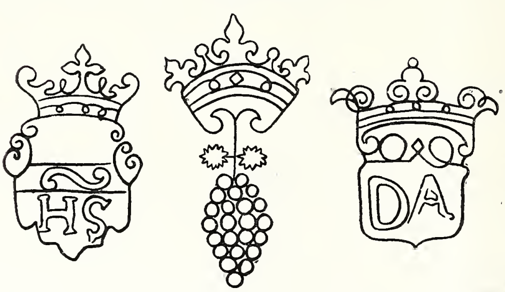
Fig. 8.



Augsburg. Penig. Freiberg. Waldenburg.

mark, of 1750, consists of initials only the earliest date being 1598; another, of 1790, contains the name of the maker only, "Sehlema," with no device. This is the first date we have of the introduction of a name only without any device.

Fig. 9.



Hans Staiger, 1581. Aukther, 1685.

It is interesting to note that the paper mill at Dresden was given an exclusive right to make paper bearing the Dresden arms as a watermark. Fig. 8 shows this mark A.D. 1500. Kirchner notes that marks of different sizes were used for papers of different sizes.

F. Von Hossle, technical director of chemistry at the paper mill, Hegge, Bavaria, wrote a monograph, dealing with the Hegge paper mills. In searching through old MS. he unearthed some old watermarks, notably Hans Staiger, 1581, and Aukther of 1685 (Fig. 9), both of which bear the makers' initials. These mills originally belonged to the Abbots of Kempten, but when the monastery of Kempten was secularised in 1802, the mills became the property of the Bavarian Government. One mark in 1809 shows the survival or adaptation of the bunch of grapes pendant from a crown with stars on either side (Fig. 9).

Early English Marks.

The first English paper mill was erected at Hertford or Stevenage—the Sele mill, where John Tate the younger, the son of John Tate, who was Lord Mayor of London in 1476, made the first white printing paper. In "De Proprietatibus Rerum," printed by Wynken de Worde, one of our earliest English printers, in 1495, appear the following words:—

"And John Tait the Younger joye mote he broke
That late hath in England do make thys paper thynne
That now in our Englyssh thys booke is prynted inne."

Fig. 10.

1495. John Tate.

When Henry VII. stopped at Hertford Castle on May 25th, 1498, he visited the mill, as is shown by an entry in his household book, which still exists, and under that date is an item "for a rewarde geven at the paper mylne

16/8." There is also one in the following year, "geven in rewarde to Tate of the Mylne 6/8." Tate's watermark was a circle enclosed by a star or wheel of eight points.

Spielman, who erected the second and a larger mill at Dartford was jeweller to Queen Elizabeth. The first folio edition of Shakespeare was printed by Isaac Jaggard and Edward Blount, in 1623, on paper made by Spielman, the second English paper-maker, the watermark being a cap. A fool with cap and bells was also Spielman's crest, which can be seen on his tomb at Dartford Church. No doubt he borrowed this from an earlier mark.

It is often supposed that Spielman's mark gave rise to the name of "foolscap" for paper of a certain size. This is now regarded by many as being a mistake. The name "foolscap" is presumably derived from the Italian "foglio-capo," a folio sized sheet.

A story has been freely circulated in the Press, from what source I know not, that the Italian "foglio-capo" was ordered by the Rump Parliament to be substituted for the Royal Arms in the paper used for the journals of the House of Commons. But it is said that no paper so marked found its way into England before 1659, and it was thought that the story owed its origin to the topical allusions which the Royalists contrived to perpetrate in the case of papers introduced from Holland during the Cromwellian *régime*. For example, in 1649, a large hat, to denote the broad-brimmed beaver worn by the Puritans. In 1651, four crowns; and in 1557, a regal crown—all symbols likely to be obnoxious to the ruling powers—were to be found in many papers.

The Rev. Joseph Hunter, in his paper in *Archæologia* (vol. xxxvi., p. 447), gives several specimens of English watermarks in the 14th century, as figure, 1337; a circle enclosing the letter S, surmounted by a *fleur de lis*, 1334; a circle enclosing the letter h, 1345, accounts of works at Dover; figure perhaps of a water lily, 1360; sprig, 1370; drawn bow with arrow, 1370. All these are from English MSS., but most probably the paper came from abroad.

Mr. John Bruce, in a paper in *Archæologia* on the authenticity of the *Paston Letters* (Vol. 41, p. 22), writes:—"I believe I may say that he (Sir John Fenn) was the first English antiquary who gave representations of these marks and applied them as a test of antiquity."

In the original edition of the *Paston Letters* (1787, 1789, 1823) there are plates of watermarks dating from 1422 to 1509.

Apparently most of the watermarked paper used in England was made abroad, even up to the eighteenth century. Blades believes that the paper used by Caxton was of foreign make. It is said that Caxton's "Game of Chess" includes upwards of fifty different designs of watermarks. In the eighteenth century much paper was made abroad for the English market.

There are a series of "Pro Patria" watermarks for foolscap, with different designs of a female figure within a fence, which appears to have developed in course of time into a representation of Britannia. Some of these have the initials "G.R." crowned in a circle. Most of them appear to have been made abroad for the English market. The ordinary figure of Britannia, as now used on foolscap paper, is not a correct reproduction of the figure on the pennies and halfpennies, but there are some watermarks of Britannia with a helmet and trident. (Fig. 18).

Mr. R. B. Prosser draws attention to an interesting patent (No. 1774) taken out in 1790 by John Phipps, of Leytonstone, Essex, for teaching writing and drawing by the aid of watermarks in the copy-book or drawing copy. The full title of the patent is given in the "Chronological Index," 1854. It refers to "wove or washing wires." Mr. Prosser says that this is the earliest example he knows of the word "watermark." Probably there are earlier examples, but certainly most of the old references are to "papermarks." Mr. Prosser adds that the same proposal was patented by William Ironside Tait, of Rugby, in 1848 (No. 12361), and again by Dove, in 1864 (No. 2037).

Right to Use the Arms of Scotland.

The first paper mill appears to have been erected in Scotland, at Dalry, on the water of Leith, in 1675. The Privy Council granted the permission for the establishment of further mills in Scotland, "but without hindering any already set up," and also "to put the coat-of-arms of this kingdom upon the paper which shall be made at these mills." On July 10th, 1695, by Act of Parliament, Dupin and his partners were granted the privilege of a factory, with the right to establish it under the name of the Scotts White's Paper Manufactory.

I have said enough, I think, to show that

most, if not all the factories of early origin had special rights, monopolies and privileges, and were owned or controlled by great families or monasteries.

The first mills of this country possessed special privileges, as well as those of Scotland and those on the Continent. The exclusive right of using coats-of-arms was granted, as we see, to certain mills. Watermarks possessed then peculiar significance.

General Character of Watermarks at Different Periods.

Although I shall not venture to express an opinion on the vexed questions that have puzzled bibliophiles and others who have made a study of the subject, I may perhaps without much fear of contradiction convey in general terms the character of the watermarks from early times up to the present.

I venture to suggest that watermarks may be divided under two heads, viz., simple and compound. The simple marks are those such as the bull's head, which Joseph Hunter found in a MS. account book dated 1302, the paper of which is believed to have been manufactured at Ravensberg, in Swabia, by the Holbein family. Paper marked with a bull's head, the arms of the Holbein family was used in a paper of this date. In Pomerania, Friesland, Austria, Bordeaux and Paris, records exist written on "bull's head" paper. Fust and Schoeffer use it in their first impressions. And we have in addition to the globe surmounted by a cross, said to be the first watermark, a symbol typifying Christ's advent on earth, a clapper or rattle such as was used in olden times by lepers to warn the approaching wayfarers. This symbol related to the Holbein hospital for lepers at Ravensberg, to which a part of the profits from the family's mills was assigned. These are merely examples of simple watermarks, and suggest how they came into being. It must be realised that papermills of those days belonged to some big family, or more often perhaps to monasteries. The use of paper was limited to people of culture and learning who were mostly to be found in the monasteries; hence the ecclesiastical origin of most of the early watermarks.

Taking the 600 watermarks of France recorded by Midoux and Matton, for the fourteenth and fifteenth centuries, I find on making a sort of rough classification, that they are made up approximately as follows:—

Simple Marks.

Description of Mark.	Time Mark Occurs.	Description of Mark.	Time Mark Occurs.
The letter P.	42	Cock	3
,, Y.	19	Dove	2
Stag's Head	9	Post Horn	2
Bull's Head	33	Crown Single	10
Paschal Lamb	4	Bell	7
Holy Grail	29	Crescent	4
Unicorn	32	Sword (single and crossed)	4
Dolphin	5		
Hand	38	Rose	4
Crossbow	18	Trefoil	4
Dog	18	Pear	6
Anchor	44	Pair of scales	4
Cardinal's Hat	2	Fleur de lis	10
Lion	9	Heart	3
Leopard	15	Dragon	4

Compound Marks.

Description of Mark.	Time Mark Occurs.	Description of Mark.	Time Mark Occurs.
Crown and flame	10	Arms of Champagne, etc.	14
Arms of France, &c.	33	Tower and battlements	5

Out of the 42 "P's," 25 are forked, which conveys to my mind the possibility of their being intended as a compound of the letters P and Y.

In addition to the above there are many marks which appear only once or twice, some of them ecclesiastical, such as the Virgin and Child, or the head of a Saint. It is evident that a very large number, directly or indirectly, are ecclesiastical, and were adopted by the monasteries as a means of identifying their paper. The earlier marks, notably those of the South of France, began by being simple. Those of the north, of later date, are largely compound. Midoux and Matton mentioned that they never found certain marks, such as anchors, pots, arms of France and arms of Champagne, used in paper made in the south of France, whereas they found them very largely in papers used, and presumably manufactured, in the north of France. They did not consider that one mark belonged to one factory, because paper-makers of different countries used at the same time similar types of the same mark, distinguished only by particular signs. Hence so many varieties of the *fleur-de-lis*, the P, the *tête-de-bœuf*, the unicorn, the anchor, the pot, the hand, &c.

It is impossible to refer to the thousands of designs used for watermarks, but it may be well to take note of some of those which have given their names to special forms of paper, such as pott, foolscap, crown, post, &c.

The Pott mark is one of very great interest,

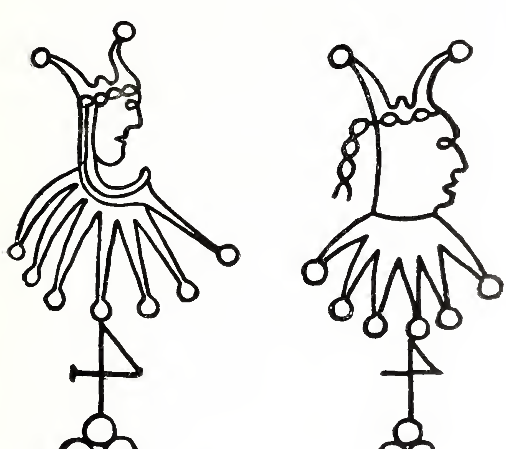
as in its highest form it is very early in date. Sotheby has a specimen dated 1352. Originally a representation of the "Holy Grail" or sacramental vessel, it gradually degenerated into an ordinary jug or pot. It is however interesting to note that in the annexed late figure, although a common jug is represented, the Christian emblems are still retained. (Fig. 11.)

FIG. 11.

POT.

Foolscap. — This is of considerable antiquity, and is found on the paper of Caxton's "Golden Legend." The annexed figures show the survival in the seventeenth and eighteenth centuries. (Fig. 12.)

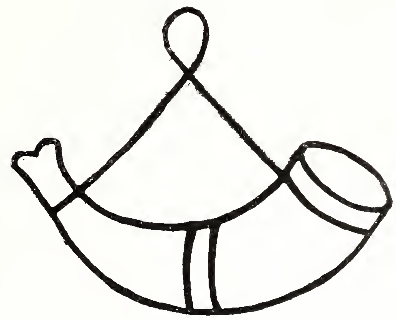
FIG. 12.



FOOLSCAP, 1605. FOOLSCAP, 1701.

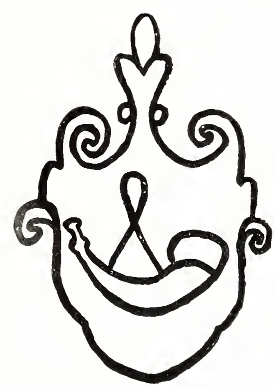
The Britannia, which has taken the place of the old foolscap, has already been referred to. The post horn which gives its name to post paper is an early mark, it is found in the year 1333, the annexed figures show it in later forms. (Figs. 13 and 14.)

FIG. 13.



AB. 1431.—POST HORN.

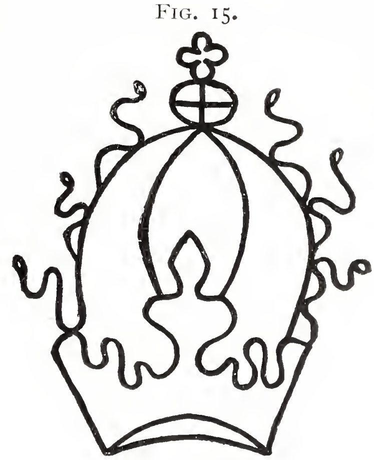
FIG. 14.



1723.—HORN IN SHIELD (Dutch paper).

The crown is found in all kinds of forms at an early date. (Fig. 15.)

FIG. 15.



1616.—CROWN.

The hand is also an early mark—the annexed figure shows it at a comparatively later date. (Fig. 16.)

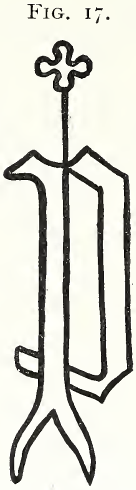
Fig. 16.

1578.

Caxton's watermarks seem to indicate his use of Netherlands paper.

Fig. 17 is one of the watermarks used by Caxton.

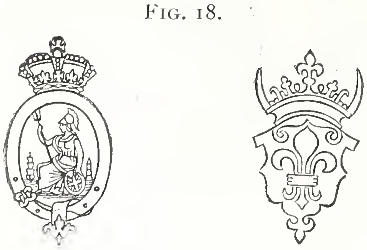
Fig. 17.



1347.—Duke Philip of Romiere (Caxton).

Fig. 18 shows two watermarks used for foolscap and medium-sized papers. The foolscap contains an improved figure of Britannia.

Fig. 18.



Foolscap. Medium.

Old marks still in use.

What Importance to Attach to Slight Differences.

I venture to think that the study of the evolution of the watermark is somewhat disappointing, and that one or two investigators have placed undue importance upon slight differences. Had they regarded it from the paper-maker's standpoint, they would have realised that such differences are inevitable. Sotheby, in his "Principia Typographia," appears to take the commonsense view. Thus he notices that 2, 4, 8 or 12 moulds were used at a time. This he concludes from the number of slight variations in the watermark, on the assumption that the watermark on each mould is distinctive, as can be seen on sheets of unicorn and P. wire stitching. This is a view which would appeal to a practical papermaker. Jansen noticed that the marks were almost endless. Mr. Harold Bayley in his "Notes on Water-marks," appears to attach undue importance to slight differences. He says (p. 10) "Every one familiar with the technicalities of paper-making will recognise that each different design necessitated either a new, or an altered mould, and even nowadays moulds are most expensive implements." Contrast this with the statement made by Herring in 1855 (p. 90), "One's signature, crest or device of any kind, rendering the paper exclusively one's own, can now be secured in a pair of moulds, at the cost of merely a few guineas." To-day such designs can be and are produced by hand at a few shillings each, and individual letters at a few pence. I have had some experience in the making-up by hand of autograph facsimilies in metal wire and can affirm that similar designs such as old watermarks could have been rapidly prepared. In the olden times no doubt the watermarks were removed and other designs placed upon the moulds as required. The marks bear evidence of having been placed very roughly on, no doubt necessitating frequent repairs, probably no two marks were made exactly alike, hence each mould or mark might show a difference. Picture to yourselves very rough and ready and possibly illiterate workmen, making, repairing, and fixing their own watermark designs. It is to be assumed that these designs were copied one from the other or from the watermark in the paper—not from carefully recorded pencil rubbings or sketches such as we now use. Remember also the making of such designs is now an industry in itself apart from paper-making. The grotesqueness and alterations

in different specimens of the same mark such as the Leopard, is therefore not to be wondered at. We should find similar differences now, if the vatmen and machinemen in different mills made their own marks. Apart, however, from these inevitable differences, a study of old marks reveals changes purposely introduced from time to time which I can perhaps give you some idea of by means of lantern slides.

I am not so surprised at these differences as revealed in old MSS., but am more surprised that each type persisted so long, and through so many generations. Nevertheless these old marks may be made a useful weapon of research if employed in the right manner. Thus, if two papers bear *exactly* the same mark, there is strong evidence of their having been derived from a common source, but if they differ in detail, as we shall hereafter see, they may belong to different countries and periods. Mr. Bayley appears to attach a symbolical meaning both to the letters P and Y, and states that the letter P is unknown as a watermark except with some embellishment such as a cross or *fleur-de-lys*, but books, such as Midoux and Matton, show P's without embellishment. Sotheby's view, which is the prevalent one, is that these letters stand for Philip of Burgundy (1349-61) and Isabella his wife. This appears to be more than probable if not absolutely conclusive. The reason that the letter P was handed down for so long is explained by Sotheby as being due to the fact that with one short exception it so happened that the letter P stood for the reigning Duke of several generations, *i.e.*, for the best part of a century. Moreover the P and Y often appear together. The P became widely established and known. (Fig. 17.)

Literature on Watermarking.

Many interesting works on this subject have been published in France and Germany, but little has been done in England since the great work of Sotheby. At the same time it may be noted that students have made extensive collections of tracings of watermarks. There is a collection in the Library of the British Museum, and a number of tracings and drawings in the Art Library at the Victoria and Albert Museum. In this collection are a large number of the tracings from the paper used for Italian prints (Andrea Mantegna, &c.), also from woodcuts and copper plates of Albert Durer. In the Art Library there are our elephant folio volumes published by Waterlow in 1855, containing a large number of specimens of paper with watermarks. This work is entitled "Illustrations of the British Paper Manufacture."

Watermarks of Recent Date.

From a historical point of view there is little of interest in the watermarks of to-day, at least those that have recently been registered and those which commonly appear in trade papers. This can be gathered by perusing the *Trade Marks' Journal*, or better still, by examining the annual extracts from the above journal as appearing in *Paper Trade Review*. Any new designs are registered as trade marks. The ancient designs which have survived through so many centuries are fast fading away. Although the initials of firms were introduced into marks of the fifteenth and sixteenth centuries, names followed later, and these constitute the chief marks of the present day. Fifty years ago most papers bore the names of makers and sometimes their crests. Foolscap still bears the Britannia mark, but the old marks, such as the hand surmounted by a star (Fig. 16), from which we get "small hand," "lumber hand," "royal hand." The cardinal's hat, which gave the name "cardinal" to a particular paper; the post horn, from which we get the "large post," "pinch post," "common post;" the "pot" the Holy Grail, and the bunch of grapes, from which the name "pott" is derived. The famous *tête-de-bœuf* and the *fleur-de-lys*, surmounted with a crown from which the imperial size is said to be derived, and the dove from which "Columbier" has presumably originated, and many others; all such marks have passed away.

There are many difficult questions that require to be cleared up in regard to the origin of old watermarks. Different investigators are somewhat at variance, but there is an immense amount of material on which to form an opinion available not only in the form of old MSS. accessible only to a few privileged persons, but in several published works.

What little knowledge I have of the subject is gleaned from the actual manufacture of paper with which I have had a good deal to do. The antiquarian side of the subject I must leave to those particularly qualified for such work. I should like to suggest to papermakers, stationers, and publishers that a closer acquaintance of watermarks of bygone ages would lend some romance and fresh interest to their trades. To the intellectual and reading

public I would commend this subject as being of peculiar fascination and interest and at least entirely new to most of them. If this paper should stimulate any one to follow up the subject of watermarks or watermarking in any of its branches, either ancient or modern, I shall feel more than recompensed for the trouble I have taken in bringing the subject to the notice of this Society.

The blocks for Figs. 4 to 6 and 10 to 17 are kindly lent by Messrs. John Dickenson and Co. The block Fig. 18 by Messrs. T. J. Marshall and Co.

Frames of historical watermarks from the Art Library, Victoria and Albert Museum, were kindly lent by the Board of Education.

Messrs. T. J. Marshall and Co. exhibited frames of historical watermarks and dandy rolls. Also, at the end of the meeting, they exhibited (in action) their miniature paper-making machine.

Messrs. Green, Son and Waite exhibited a series of watermarked papers.

DISCUSSION.

Mr. Evan Spicer (Chairman of the London County Council), in opening the discussion, said he had attended the meeting simply for the purpose of being instructed by listening to the paper, and also to have an opportunity of seeing the model paper-making machine, which was exhibited. To his mind, the question of watermarks was especially interesting to wholesale stationers and printers, who were vieing with one another as to who could secure a new watermark, and a new title to any particular paper. Occasionally they might be found to be running against, although not really copying, one another; while it might also be said that if they could not discover originality amongst themselves or their friends, they might fall back upon those who had gone before, and copy their handiwork. Personally, he would rather rely upon his own brain to get something fresh and original, and if the wholesale stationers and printers would only do the same, he thought it would be to the benefit of the trade generally. He had greatly enjoyed listening to the reader of the paper.

Sir Henry Trueman Wood thought it might be interesting if he supplemented the details of the paper by referring to an invention, which was now nearly forgotten, for the production of a kind of spurious watermark by photography. The late Mr. Walter Woodbury, well known as the inventor of the Woodbury-type process, suggested a means, many years ago, of producing apparent watermarks on paper. The process he adopted was the use of what was known as a gelatine relief, the meaning of which photographers well knew. To those who were not familiar with photographic processes it might be sufficient to say that it consisted of a film of hardened gelatine, in which the lights and shades of any photographic picture were reproduced by varying thicknesses of the gelatine. When such a film was placed in contact with a sheet of paper, and the two were subjected to heavy pressure, the result was that the paper was more impressed where the gelatine was thicker, and less impressed where it was thinner, and a picture exactly like a watermark, representing the original photograph was produced. He believed that when the invention was first brought out bankers and others who depended upon watermarks were rather concerned about it, because they considered it might lead to forgery. As a matter of fact, however, when the paper, the "photo-filigrane," as it was called, was damped, the whole thing disappeared, and the minds of the bankers were no doubt thereby relieved. He did not think the invention had any practical application, and doubted whether it was ever of any great value. It was certain, however, that any photograph, however complicated, could be reproduced on paper in the form of an ordinary watermark. He thought it worth while to mention the invention, because of the extreme ingenuity which was exercised. He thought it would be of interest if the author could state why "watermarks" were so called, because they did not seem to him to have anything to do with water at all, but were merely marks made on paper in the course of manufacture.

Mr. Thomas A. Marshall thought the term "watermark" originated from the fact that the water left the pulp in the process of manufacture where moulds were used, in which suction was employed, by the action of lifting the mould from the pulp; and in a machine the mark was impressed by the suction of water through the vacuum boxes.

Mr. Walter Young, after expressing his thanks to the author for his interesting paper, said he had expected to hear a reference made in the paper to a few of the more recent inventions in watermarking. A most remarkable invention had recently been brought out which would have the effect of revolutionising the art of watermarking. Paper-makers at present filled up their manufactories with hundreds of dandy rolls of all sizes, but by means of the new invention little pads could be fitted on the rolls for the purpose of producing the watermarks. It would thus be possible to keep an enormous number of these little pads of wire in a drawer. One of the results of the invention would be that watermarks would become very cheap for stationers, each stationer thereby being able to have his own watermark. The great manufacturers very much objected to that, because they thought they would be asked to make many more watermarks.

Mr. Marshall said the invention was not new to him as he had seen press notices of it, but he would like to inquire whether any sample sheets of paper had been made with it. If a laid dandy roll or the laid wires were examined, it would be seen that it was impossible to put little pads in to match a laid sheet of twenty wires to one inch. There must be only one chain wire, and was that chain wire to be put on the pad or on the body of the roll? With a dandy roll, making five sheets of large post, there would be four marks in the sheet, so that twenty little pads would have to be inserted; but, although they might be perfectly fitted in the first instance, the transit of the roll would invariably cause some deflection, and a bad mark would be made on the paper. In a plain rolled paper, where the seam had to be made on a wove dandy, the dandies were made as large as possible. Some Scotch workers used only five-inch dandies, but English workers used 10 or 12-inch dandies. In the 5-inch, the seam naturally came round much more frequently than in the larger sized rolls, and that seam it was almost impossible to keep out of the paper. The travelling or endless wire on which the paper was made had an endless seam, because it had to drive all the small rolls which supported it. That seam only appeared once in thirty or forty feet, but with a dandy roll they were able to get a much finer seam, which appeared after every 17, 20, or 32 inches, as the case might be.

Mr. Young, in reply to Mr. Marshall, said the invention had been tried, with most successful results.

The Chairman suggested that the discussion should revert to the direct subject of the paper. If a paper on the subject of watermarking were read 20 years hence, he had no doubt it would be found that apparatus had so wonderfully changed in bringing it up to date, that entirely different results would be obtained from those forthcoming at present.

Mr. George Chater remarked that he had listened with the greatest pleasure to the interesting historical part of the paper, and was delighted to find that that part of the subject would be further developed when the paper was printed. The bibliography, which Mr. Beadle had promised to give, would be most valuable, because those who had taken an interest in the subject found it very difficult to discover works which bore on the subject.

Mr. Beadle, in reply, said he was very interested in the remarks made by Mr. Spicer. He thought it was somewhat unfortunate that so many of the present day marks consisted merely of names, and that the beautiful devices which were still in existence, connected with different sizes of paper, were not more frequently used. If the general public were better acquainted with the fact that the sheet of paper on which they were writing bore a watermark design, probably there would be a greater eneouragement for paper makers and stationers to introduce artistic designs, and to vie with one another in so doing. With regard to Sir Henry Wood's remarks on Woodbury and his process, he thought it possible that if one took the definition of watermarking as being the act of imparting to paper a distinctive mark in the course of manufacture, it would be impossible to employ the Woodbury process in that manner. It was difficult to discover at what period watermarks were so described, but in Sotheby's and other books of that period the mark was described as a papermark, and as late as 1855, in Herring's book, occasionally he talked about a papermark, and at other times about a watermark. He did not know when the name "watermark" was first applied, but he thought it was very appropriate, because it was only possible to produce a watermark in a paper whilst the paper was in a very wet condition, and whilst it contained a great deal of moisture. When once the moisture was removed from the paper, the fibres, once and for all, retained their relative positions; but when the paper was still in a wet condition, if some design or device was placed in contact with it, the fibres could be laid aside, and so produce the watermark: in other words a watermark could only be produced in a paper when that paper contained a good deal of water; and when once the water was removed, that mark became indelibly fixed in the paper for all time, and no amount of moisture would have any effect upon the fibres. With regard to Woodbury's process, the moistening of paper after it had been embossed, stamped, or otherwise treated after it was completely made, would restore the paper to the condition in which it existed at the time it was first manufactured. Thus if paper was glazed, and dipped under water, the glazing came right away, and the paper swelled up to its original thickness, just as it came away before it passed under the glazing rolls. Although the fibre might be made to lay down and produce a lovely gloss and lustre by mechanical means after it was made, still it had an inherent power of rising up and restoring itself to the condition in which it existed before any mechanical process was applied to it. He could quite understand that beautiful effects were obtained by Woodbury's process, which consisted in compressing the paper at different points in varying degrees, the compression of the fibres producing a greater transparency, and the amount of compression varying the transparency to almost an unlimited degree; and no doubt it ought to be capable of useful and artistic treatment. Various remarks had been made about a certain invention of which he had read a good deal at times, but he had purposely avoided referring to any such matters in his paper, and he was glad he did so,

because his desire was to represent the subject in its different aspects, avoiding any patent questions, and so on. It was quite right, as Mr. Chater had said, that the key to the subject was the bibliography, and he hoped his own humble attempts might be the means of some members of the trade or others taking the subject up, studying the old books, and finding new facts of interest. They would then possibly discover that some of the statements he had made in the paper were hardly warranted. The subject was extremely difficult and full of complexities, but he had placed it before the Society to the best of his ability. In conclusion, he desired particularly to thank Mr. Wheatley for the assistance he had rendered in looking up various old books and obtaining references for the preparation of the paper; and also the three well-known firms who had produced the lovely designs exhibited for watermarking, among whom he would mention Mr. E. Amies, who had assisted in the old French watermarks shown on the screen. These firms not only produced the designs for the paper makers and stationers in this country, but also for some of the most noted firms on the Continent. He also had to thank the authorities of the Victoria and Albert Museum for their kindness in putting some old water-marks into frames for the purpose of exhibition that evening; and he also desired to thank his partner (Dr. H. C. Stevens) and his pupils who had helped him in connection with his researches.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his exceedingly instructive and able paper, said he quite agreed with Mr. Chater that the main feature of the subject was the historical interest which the watermark afforded. There was an old saying that history repeated itself. The author had shown on the screen ancient drawings of wild beasts and wild fowls, and had given a description of what they were intended to represent. One of the crazes which ladies of the present day indulged in, was to produce at various times a little book, to ask their friends to close their eyes, and draw a pig in it; and he felt sure that if some of those albums were inspected, very similar drawings would be found in them to those which had been shown on the screen. Watermarks had a peculiar fascination for him; so much so that he had got into the habit of holding the letters and circulars he received by post up to the light, to see where the paper came from; and the paper had so increased his interest in the subject that it would be difficult for him to break such a habit.

The resolution of thanks having been carried unanimously,

Mr. BEADLE briefly acknowledged the compliment, and the meeting terminated.

SPAIN'S COMMERCIAL PROGRESS.

The foreign trade of Spain appears to be steadily growing, especially in textiles, and it is interesting to note the steady increase in the exports of manufactured goods. The declared value of these exports during the year 1903 was £6,469,000; in 1904, £6,794,000; and in 1905, £7,556,000. Although many trades and industries in Spain have suffered from the general depression caused by the succession of bad harvests, others have been able to show satisfactory results. The Catalan cotton manufacturers have succeeded in opening new markets for their goods which they had never attempted to enter until the loss of the colonies obliged them to seek fresh outlets for their manufactures. Their hopes first turned to South America. Trade commissions were sent over to study local conditions, and samples were sent home of the various foreign goods that were being sold there. These were publicly exhibited, and merchants and manufacturers set themselves to produce similar goods. The result is seen in an increase of exports to all the Spanish American republics, not only of South America, but also of Central America and Mexico. Of course large profits are no longer possible, as was the case when the colonies provided a closely protected market for Catalan goods, but Spanish manufacturers have preferred selling at a minimum profit abroad to closing their mills, or selling only in Spain on long credits. Steady progress is also being made in pushing the sale of cheap cotton prints, and gray cotton cloth in Turkey, both European and Asiatic. A cheap quality of tastefully printed cotton dress flannel is finding a ready sale in Norway and Sweden, as also in certain parts of Turkey. Egypt is by degrees becoming a market for Spanish and cotton hosiery. The exports of cotton manufactures of all kinds exported from Spain in the year ended 31st December, 1905, amounted in value to £2,024,000. The cotton industry is the most prosperous branch of trade in Spain, according to the American Consul-General at Barcelona. The climate is very favourable to dyeing and printing; and although the Spanish dyers seem still to be handicapped through lack of technical knowledge, on the other hand, the large printing works are able to turn out cheap cotton dress fabrics that find a ready market in many countries. The climate and the quality of the water, particularly in the neighbourhood of Barcelona, are specially adapted to cotton printing. Many large cotton printing works exist there, and highly-paid foreign chemists are employed to superintend the preparation and blending of the colours and designs. Barcelona is an important market for the supply of sheepskins. The finest skins are collected in the province of Catalonia. Not only are they of good quality, but they are as a rule more carefully flayed and prepared than those prepared in any other part of Spain. Valencia sheepskins are also of good quality, and are, generally speaking,

larger sized than others. Next in order of merit, after the Catalonian sheepskins may be classed those collected in the district of La Mancha, in New Castile, and lastly those shipped from Murcia, which are smaller and often crumpled and badly flayed. Owing to the political situation in Russia, which, along with Spain and Italy, supplies very large quantities of sheepskins, exports from that country have been greatly interfered with, and foreign buyers have turned their attention more to Spain than they have dcne hitherto, with the natural result that prices have been forced up. German dealers have recently been through Spain, buying up all available supplies. Barcelona alone produces from 400,0c0 to 500,000 skins annually. Dealers and exporters purchase the skins from the meat contractors, the contracts being made either for a whole year or only six months, in which latter case the skins command a higher price if the purchase is made for the six months with the wool on. Spain's two best customers are France and England. A continuous stream of market produce crosses the frontier into France. Spanish wine growers depend almost entirely on the latter country for the sale of their common red wines. France supplies Spain with silks and other kinds of dress goods, machinery, chemicals, china and glass ware, fine dressed skins, and many other articles. Spain sells to England her ores, fruit, and sherry, and England sends Spain large quantities of coal, machinery, woollen cloth, and fine cotton yarns. The trade of Spain with Germany is of considerable extent. There is hardly a line of manufactured goods which does not find a place in Germany's exports to Spain, from the powerful modern locomotive to the modest little brass hooks and eyes, from potato dextrin to the latest products of chemical science. Spain sends to Germany her ores, cork, fruit, wine, and cotton knitted goods. Spain buys of Belgium steel rails and other metal manufactures. Switzerland's trade with Spain consists of watches, cheese, embroideries, and condensed milk, in exchange for which Spain sends her wine and cut corks. The trade carried on between Spain and the Scandinavian countries is almost confined to timber, dried codfish, and butter. Spain sends to Norway, Sweden, and Denmark, wine, raisins, olive oil, salt, fruit, and pig-iron. Russia supplies Spain with timber, wood-pulp, and timber from her Baltic ports, and wheat and petroleum from the Black Sea, and takes in return wine, oil, fruit, salt, copper ore, iron pyrites, and pig-lead. There is a considerable export of shot of all kinds from Spain, and particularly of pistol and rifle bullets, and Barcelona is one of the principal places of production. There are two shot factories in Barcelona, one in Valencia and one in Linares, the latter town being the centre of a lead-mining region in the Province of Jaen, in southern Spain. The two Barcelona factories are the most important, and are large exporters of shot to various countries, and particularly to the Dutch Indies, as to the capacity of the Barcelona factories, it may be stated that the most important of them was able recently to execute an order for thirty tons of shot within a fortnight. According to the official returns of the Spanish foreign trade, it appears that during the year ended December 31st, 1905, hides and skins were exported to the value of £760,000 as compared with £587,000 in 1904; fruit and vegetables £4,928,000, as compared with £5 748,000; cork in sheets and stoppers for bottles £1,484,000, as compared with £1.348,000; ores and metals £11,752,000, against £10 928,000; preserved foods £1,424,000 against £1,180,000, and wine £2,512,000 as compared with £2,784,000. For the first time since the loss of her colonies, the volume of Spanish exports in 1904, exceeded the imports into the country.

RUBBER IN FRENCH WEST AFRICA.

A good deal is being done in French West Africa to encourage the cultivation of rubber. There was great adulteration, and destruction of rubber trees, and the French Government had to consider how to stop both, and to improve the methods of cultivation and collection. In French Guiana stringent orders were issued as far back as 1899, forbidding the exportation of adulterated rubber, and as far as that colony was concerned, the practice was checked, if not entirely stopped, and the price of Conakry rubber rose rapidly in consequence. Since then, the question has been whether similar measures could be taken for French West Africa, as a whole, so as to improve the position of all the rubber exported, from the Government-General. The Inspector-General of Agriculture visited all the European rubber markets, with the result that in February, 1905, an ordinance was published applicable to the whole of French West Africa. It deals with—(1) the suppression of adulteration; (2) the preservation of existing rubber plants; (3) the creation of new plantations; (4) the creation of schools of instruction in the methods of cultivating and gathering rubber. The best rubber, known as Conakry "niggers," continues to be exported in sacks, bearing the Customs seal as a guarantee of quality, but every other quality may be exported without it. The application of the new regulations proved very beneficial in the Beyla district of Upper Guiana. The rubber produced there improved so much that it has been given a special quotation in the Bordeaux market under the name of Beyla "niggers."

As regards the preservation of existing rubber plants, irreparable harm had been done before the Government interfered, so that the Government is turning its chief attention to the creation of new plantations. It has been found more advantageous to plant rubber trees, such as hevea, funtumia, ceara, and possibly castilloa, rather than the rubber vine. The only way of successfully propagating the latter has been proved to be by sowing it at the foot of the tree which will ultimately serve as its support; but

Captain Cromie, from whose report this has been quoted (No. 3543, Annual Series), says that cuttings and sowings in nurseries for transplanting do not give good results. The vines, therefore, can only be sown in wooded regions in the place they are intended to occupy. In many portions of French Guinea, where the soil is unsuitable for landolphias, the ceara would be available. From the various experiments that have been made, it results that cearas six years old give an average yield of about $\frac{1}{3}$ lb. of rubber per tree. The principal experiments in Guinea have been with heveas and castilloas, and in Dahomey with funtumias, all with encouraging results. In Upper Senegal-Niger the first attempts at planting rubber were made at the places where the practical schools have been established. The largest of these was at Bamfora, where 95,000 landolphias were sown in nursery beds and 16,000 in the places they were definitely to occupy. These latter were the only successful ones.

THE PROGRESS OF PERSIA.

Persia has an area of 628,000 square miles, and a population of 9,000,000. The country consists for the most part of a great elevated plateau which is nearly level. There are also several mountain ranges, some of them rising to such a height that the peaks are clad with perpetual snow, while there are many deserts, some of considerable extent. The rivers are of great length, extremely wide and shallow. The lakes number about thirty, none of which have, says the American vice-consul at Teheran, a visible outlet. The immense valleys, many of them 100 miles wide, are covered with luxuriant vegetation. The plains are studded with mulberry, sugar, and cotton plantations, rice fields, and orange orchards. The principal cities are Teheran, Tabriz, and Ispahan. Besides wheat, barley, rice, fruits, and gums, silk is produced in large quantities. The opium industry is increasing, and tea plantations, which were started a few years ago, are producing a fine grade of tea. The staple or standard manufactures which enter into the foreign trade consist chiefly of carpets—of which there are thirty different kinds—rugs, shawls, embroideries, and silver and brass work. Machinery is not used in the production of the finer grades of tiles, all of these being hand-made. The mineral deposits are considerable, but the great distance from shipping ports or markets has stood in the way of any great development. The chief minerals consist of lead, copper, tin, iron, sulphur, and salt; traces of oil have been found in some of the provinces. The Persians take great interest in breeding fine sheep, and their horses are celebrated for their splendid pedigrees, not being excelled by those of Arabia. The streams are rich in fish, especially the sturgeon, of which large quantities are dried and exported. Within the past thirty years a very decided revolution has taken place in the conveniences and social surroundings of the Persian people. Much of the primitive simplicity and severity of former times has given place to a modernised and luxurious taste. This has been fostered by the visits of the rulers and wealthy people to Europe, who appreciating the refinements of the West, have introduced them into their homes, making them an example that has been speedily and widely imitated. These innovations have brought the habits and customs, in the public and domestic economy of the national life, into a closer relationship with the higher developments of foreign fashions and usages. In order to participate in the encouragement of this aspiration, and provide the means for its support, the foreign business world is encouraged to bring into Persia its manufactures and the products of its handicraft. Within the last few years, Russia, by reason of proximity of situation, convenience of transportation, the application of the bounty system to certain manufactures, the prohibitive transit duty on goods by the most direct route, the infinite resources of petroleum, the extension of cotton growing, and large supplies of wool, corn and grain, has become a formidable rival of all outsiders in the Persian trade, in the domain of her own products. Russia heads the list of nations from which Persia buys, selling to the Persians during the year ended March 31st, 1904, £272,000 more than Great Britain. A great hindrance to the development, improvement and extension of trade and industries in Persia is the want of good roads and good means of transportation. The trade is carried on principally by caravans. The carrying capacity of the camel is four hundred pounds, the mule three hundred pounds, and the horse two hundred and fifty pounds. The cost of transportation per animal, carrying three hundred pounds, between Teheran the capital, and the ports, with the cities in the line of route, is as follows:—Trebizond, *viâ* Tabriz and Kazwin, 1,100 miles, £5 to £6, time ninety days; Resht, *viâ* Kazwin, 230 miles, £1 12s. to £2, time twelve days; Bushire, *viâ* Shiraz and Isphahan, 800 miles, £4 to £5, time seventy days; Bagdad, *viâ* Hamadan, 600 miles, £4, time sixty days; Bender Abbas, *viâ* Kerman and Yezd, 1,000 miles, £6, time ninety days. The goods which find favour in Persia, are the following:—All kinds of cotton goods, boots and shoes, nails, bicycles, and accessories, canned fruits and meats, cigars and tobacco, kerosene, stones, enamelled ware, electric apparatus and machinery, cutlery, drugs, hardware, rubber hose, &c. As regards Persian exports the trade in these has, of late, been fairly brisk. Silk and woollen rugs have been in great demand. Imitation cashmere shawls, beautiful in colour, shading and texture, still form a product of the loom, and are largely exported to Turkey. Brocades and embroideries are exported to countries near and far. The turquoise continues a favourite gem, and is in demand in most parts of the world. The opium poppy is cultivated largely in several provinces, and the drug, when prepared, is exported to China. Rice, cotton, dried fruits and nuts, are sent to

Russia, India and England. Persia figures but little in the commercial world, and probably will not attain any considerable importance until she opens up new roadways, builds railways into the interior, and adopts modern machinery in her manufactures. The irrigation works which once fertilised great tracts of land, have become neglected, and consequently rich fields that formerly yielded great quantities of grain are now filled with rocks and débris, thus rendering cultivation practically impossible. Persia, if the industrious and enterprising element of the country adopt modern methods in developing its vast resources, and providing better means for their transportation, will doubtless, in a few years, return to its former standing among the nations of the world, when its population was rated at a great many more millions than the present Empire could possibly support.

GERMAN AND ITALIAN EMIGRATION.

During the eighties of the last century, Germany sent as many as 200,000 emigrants to the United States in a single year, that is, ten times as many as she is sending to-day. The healthy development of German industries at home turned the tide of German emigration from America to the cities,' and the marvellous growth of such cities as Berlin, Chemnitz and Nuremburg has been the result. The United States Consul at Chemnitz in a recent report on the subject, says that the German Empire has so well understood, not only how to stem the tide of a great emigration, but to render it possible for the people to better their condition, and to found new homes within the limits of the mother country, where the population is already very dense, and is still increasing at the rate of 800,000 per annum. In Italy, during the year 1905, more than 700,000 emigrants left to seek homes in North and South America. This represents a population almost as large as the annual increase and gain which the German Empire adds to its population. Owing to the continual heavy drain in some parts, especially Venetia and Calabria, whole districts have become practically depopulated. It not uncommonly happens that a large body of people, with a priest at its head, starts for the sea port to begin the journey to some part of America, in order to seek out a new existence. The South American States, particularly Brazil, are the chief goal of the Italians, but the United States and Canada, too, receive a considerable part of this great stream of emigiation. With their uncommonly small needs, and surprisingly high degree of agricultural efficiency, there is no question but that the Italian emigrants will succeed in making good farmers. Their nature is also such that, as soon as they get comfortably established, the desire to live well, begins to assert itself. In this way Italian colonies become communities of great purchasing power. The Italian colonisation in Brazil has increased in such a measure, that in some districts, the Italian language is beginning to crowd out the Portuguese, and the whole life is taking on quite an Italian character. Whether Italy, like Germany, will ever be able to check the exodus of the rural population seems more than doubtful. Unlike England and Germany, Italy will never be likely, even proportionately, to become a great industrial country. France has succeeded in keeping the pendulum evenly swinging between her agricultural and her industrial interests. This is due to the fact that France gives few emigrants to foreign countries, while the birth-rate adds but little in the shape of an increase to her annual census. Italy was also able to do this, until the enormous emigration already referred to, began to exert such a powerful influence upon her agricultural interests. The next few years must tell the tale whether the Italian tide of emigration will begin to ebb, in consequence of more favourable conditions at home.

THE RESOURCES AND TRADE OF BRAZIL.

Brazil began the twentieth century with 17,000,000 people, a territory larger than that of the United States, and undeveloped resources surpassed by no country, with the possible exception of the United States and China. Of all the South American countries Brazil is the most extensive. It contains an area of 3,200,000 square miles, is 2,630 miles long, 2,540 miles wide, and has a population of 17,000,000, mostly of Indian origin. It borders on every country of South America except Chile. The rivers are numerous, among the largest being the Amazon, Madeira, Negro, Para, Tocantins, Parana, and Sao Francisco. In the extreme northern part of the country are the llanos, or grassy plains, on which roam millions of horses, many being caught and sold in the different markets of the world. Central Brazil, especially that part lying contiguous to the Amazon and its tributaries, is called the forest region. It abounds in Para rubber and palm trees, mahogany and dye-woods. The eastern and southern parts form the great Brazilian plateau. This section, according to the United States Consuls in Brazil, is especially adapted to the cultivatien of the coffee tree, the production of sugar, cotton, tobacco, rice, and fruits. Among the minerals, besides gold and diamonds, iron of superior quality is abundant. The emerald, ruby, topaz, sapphire, garnet, and other precious stones are found in considerable quantities. Considerable quantities of corn are grown in the Amazon basin, but none for export. Brazil is a country of varied and wonderful resources, and with the introduction of up-to-date methods, its development could, it is said, be extended, so that within a few years it would produce enormously and take high rank among

the leading commercial countries of the world. The exports are increasing year by year, especially those of rubber, the value of the latter amounting to over 11 millions sterling in the year 1904, as compared with 10 millions in 1903. The introduction of the bicycle, automobile, and other rubber-tyred vehicles has given the rubber production an impetus that has caused Brazil to forge to the front as a rubber exporting country. The coffee trade is being extended, and has a very healthy growth. The United States buys 50 per cent. of the coffee exported, the total value of the exports of this article to all countries in 1904, amounting to £19,958,000. Of the three leading countries that sold their products to Brazil in 1904 Great Britain ranks first with £7,187,000; Germany second with £3,282 000, and the United States £2,885.000. Argentina sent goods to the value of £2,663,000, France £2,314,000, and Portugal £1,900,000. During the first six months of 1905, the imports into Brazil from Great Britain amounted in value to £3,608,000, from Germany £1,772,000, the United States £1,485,000, Argentina £1,608,000, France £1,160,000, and from Portugal £1,060,000. Of the imports, the leading articles are manufactures of cotton, manufactures of iron and steel, wine, machinery, wheat flour, wheat, coal, jerked beef, food products, wool and woollen manufactures, paper, chemicals, kerosene, earthenware, &c. As regards the ports at which the imports are entered there were as follows, in the order of importance as given:—Rio de Janeiro, Santos, Para, Pernambuco, Bahia, Rio Grande do Sul, Porto Alegre, Maranhao, Ceara, Maceio, Paranaqua, Florianopolis, and Cabedello. The greatest increase in imports, comparing the year 1904 with 1903, were in iron and steel manufactures, a difference of £239,214; in flour, a difference of £326,906; wheat, a difference of £159,434, and machinery and tools a difference of £164,711. The total value of the imports into Brazil in 1903, amounted to £25,178,000; in 1904, £26,698,000; and in the first six months of 1905, to £13,616,000. Of the exports from Brazil, coffee and rubber, as pointed out above, comprise the principal articles, the others being cocoa, cotton, hides, tobacco, manganese, &c. The total value of the exports in 1903 amounted to £36,986,000, in 1904 £39,422,000, and in the first six months of 1905 to £18,370,000 (approximately). In recent years a large amount of foreign capital has been invested in Brazilian enterprises, especially in the city of Rio de Janeiro, in Sas Pauls, and in the Southern States. German capitalists have established steamship lines for coast service, and other capitalists have acquired various undertakings at Rio de Janeiro and elsewhere. During the year 1904, there entered at the several ports of Brazil, 17,407 steamers and sailing vessels, with a tonnage of 71,879,563 tons, being an increase of 1,339 in the number af vessels, and 811,265 in tonnage on the year 1903.

HOME INDUSTRIES.

British Insurance Losses at San Francisco.—In the *Journal* of April 27th, and at a time when very wild statements were being made as to the losses of British insurance offices consequent upon the San Francisco disaster, it was said in these notes that "the actual liability will probably work out at something under £10,000,000." It is impossible, even now, to estimate with any exactitude the actual loss. The aggregate liabilities in San Francisco of only four companies are known—the Liverpool London and Globe, the London and Lancashire, the Royal, and the State Fire—and these amount in all to £3,467,000, with a premium income in San Francisco of £52,510, so that the average liability is 66 times the premium income. Upon this basis, it may be roughly estimated that the total liabilities of the British fire offices will not exceed £12,700,000, and the *Economist* is "inclined to the opinion that the net losses of the British companies will not exceed £6,000,000 to £7,000,000. That these losses, or much larger ones, can be met without difficulty, is demonstrable." The total fire and general reserves of all these offices now exceed £35,000,000, mostly invested in easily negotiable securities, and a net loss of £6,000,000 or £7,000,000 represents only three years surplus profits on their fire business. It is fortunate too that 1905 was an exceptionally prosperous year for British fire offices. The accounts of most of the large companies have now been published, and show a substantial increase in their gross profits as compared with 1904, which witnessed the great fires at Baltimore and Toronto, with their loss to British offices of £1,800,000 and £900,000 respectively. The soundness of the financial position of the great insurance companies is shown by the fact that about 65 per cent. of the amount distributed in dividends was derived from interest on investments forming the reserves, and allowing for the profits derived from the life, marine, and accident business less than one quarter of the dividends paid were taken from fire insurance profits.

The Railway Outlook.—It is a little curious, at least it is worth noting, that the quotations for home railway ordinary and deferred stocks are now lower than they have been at any time during the present year, although over three months dividend has accrued. Prices have fallen whilst the intrinsic position has been improving. The uncertainty of the international situation, and nervousness as to attacks by the Labour Paity upon the railways, go far to explain this apparent anomaly which offers the prudent investor a favourable opportunity. For the present situation and near outlook for the leading railways are very satisfactory. The traffic returns for the half-year to date are good, more particularly as regards the great trade lines, and the latest returns exhiblt increases in excess of the weekly average since January 1st last. Allowing for accrued dividend, and upon the basis of present prices, the yield on the

ordinary stock of the Taff Vale is £4 18s. per cent.; on the North London £4 17s.; on the City and South London £4 14s.; on the London Tilbury and Southend £4 10s.; on the Central London £4 8s. 6d.; on the London Brighton and South Coast £4 4s.; on the North Stafford £4 3s.; on the London and North Western and the Great Western 4 per cent.; the North Eastern £3 19s. This last-named company has published an increase of £137,600 for the first four months of 1906. Last half-year an aggregate increase of £127,500, sufficed to raise the dividend by ½ per cent. So with the North Western. With traffic expansion on the same scale as at present last half-year it augmented its dividend by ¾ per cent. At present the gross receipts of the Great Northern are a little better than they were six months ago, and for the second half of 1905 it raised the deferred dividend by 1 per cent. per annum. Even the companies mainly dependent upon passenger traffic, such as the Great Eastern and the Southern group, which have hitherto shown the least satisfactory results, are now publishing more encouraging returns. Nor is there any reason to suppose that the general improvement in railway returns will cease with the present half-year.

Home Trade with the Colonies.—The figures given in the Statistical Abstract for the British Empire recently published show in a very striking way the growth of foreign trade with the Colonies and India, and the comparative slowness of growth of the trade between them and the mother country. If the statistics relating to British trade with the colonies of foreign countries are examined it will be seen that it makes very slow growth, where there is any, and this is not surprising having regard to the steps taken by foreign governments to handicap the foreigner. But under the British system, and apart from the preference given by some of the greater colonies to British products, the foreigner is under no disability in his trade with the British colonies. And so he moves ahead in his dealings with them. Taking the trade of each part of the British Empire outside the United Kingdom with foreign countries it will be found that in the fifteen years, 1890-1904, the imports increased from £55,287,000 to £107,158,000, an increase of £51,871,000. On the other hand, the trade between the United Kingdom and other parts of the Empire increased only from £106,517,971 to £135,669,234, an increase of £29,151,263. If the trade done with India is deducted the increase is from £61,554,816 to £80,558,651, an increase of £19,003,835 only. Deduct the trade done by foreign countries with India and their trade with the British colonies has increased in the same period £39,863,000, or more than double that of the United Kingdom, notwithstanding the substantial preferences given by Canada and some of the other colonies in recent years.

Principals and Orders.—In his report upon the trade of the Moscow district for 1904, Mr. Consul Grove urges what has been urged in many other Consular reports of late, namely the advisability of heads, or at all events partners in big firms dealing with Russia going out periodically in person to see for themselves, and, what is quite as important, to be seen. When a subordinate goes as representative he sees a subordinate, whereas when a principal goes out he sees principals, which means a great deal of difference. The heads of large Russian firms often know English well, certainly French or German. The partner or chief would be able to give an answer "Yes," or "No," to an offer, or request, whereas a subordinate would very likely have to refer home for instructions, and meanwhile the order may go elsewhere. In Russia individuality, says Mr. Grove, that is the knowing personally the individual with whom you are transacting business, goes a long way. The Germans know this and act upon the knowledge, the British do not, and this probably goes some way to explain the rapid growth of German exports to Russia as compared with British. The figures deserve to be remembered. A dozen years ago the imports from the United Kingdom were more than one-fourth of the whole of the Russian imports, and from Germany not much more than one-fifth. Ten years later the imports from Germany were considerably more than a third, and those from the United Kingdom less than a sixth. Here are the figures:—

	Total roubles.	From United Kingdom.	From Germany.
1893 ..	463,546,000 ..	118,416,000 ..	101,184,000
1903 ..	681,670,000 ..	113,870,000 ..	241,897,000

It will be seen that whilst in the decade German exports to Russia increased in value 140,713,000 roubles, the imports from the United Kingdom actually decreased 4,546,000 roubles, although the value of Russian exports to the United Kingdom increased in the same period from 155,136,000 roubles to 189,101,000 roubles.

San Francisco and British Trade.—It is certain that, given no further earthquakes, San Francisco will rise from its ashes quickly, and in doing so it must greatly stimulate productive energies. In this connection the New York *Sun* says:—"Almost every industry will feel the effect of the recent terrible conflagration. The people who escaped with their lives, as a general rule, saved little else. Even their clothing, except what they actually wore, went up in smoke. So did the piece goods on the shelves of dry goods merchants from which new clothes might be made. A heavy demand will thus fall upon the cotton mills of Fall River, the woollen mills of Providence, the shoemakers of Brockton, the hatters of Danbury, the shirtmakers of Troy, and the innumerable industries called upon to supply light and showy fabrics and ornaments worn by a large part of the population. The brass makers of Connecticut will have to supply gas and electric fixtures, the furniture makers of Michigan will feel the increased

demand for their product, and there is hardly any line of human energy which will not be called upon to help in the restoration of the city to its past or a new greatness. Under these circumstances it is hardly strange that some people have been measuring up the losses against the stimulation of the country's industries, and half convincing themselves that they can see a gain almost compensating for the loss already suffered. The keynote of this contention is that money which has not been actively employed will now to a large extent go into circulation." Of course, American industries will be the chief gainers by the demand created by the reconstruction of San Francisco, but the gain cannot be confined to the United States, and it is reasonable to assume that some portion of the increased demand will be satisfied by British manufacturers.

NOTES ON BOOKS.

Royal Commission: St. Louis International Exhibition, 1904. The British Section. Compiled by Sir Isidore Spielmann, F.S.A. London: Issued by the Royal Commission, 1906.

The Royal Commission have produced in this handsome volume a fully illustrated record of the exhibits in all branches of the British Section. The British Royal Pavilion at the Exhibition was reproduced from the beautiful Orangery of the Royal Palace of Kensington, built by Wren, and the chief features and details of both buildings are shown in the illustrations. The garden surrounding the Pavilion was designed on the lines of those that were usually attached to the old mansions in England during the reigns of William and Mary, and Anne. It is interesting to note that the French Government founded its Pavilion upon the design of the Grand Trianon at Versailles, and the German Government theirs upon the lines of the Castle at Charlottenberg. As is said in this volume: "These, with the Orangery, afforded an interesting comparison, illustrating the difference of aim and treatment between our neighbours and ourselves." There is a great variety in the contents of the volume, which gives an excellent idea of the wide range of the British contribution to the great show at St. Louis. The numerous galleries are shown as they appeared, with the pictures on the walls and the other exhibits in their cases.

The Art Section naturally takes up a large proportion of the space, but the Scientific and Industrial divisions are not overlooked. The paintings, engravings, mezzotints, etchings, and drawings in black and white are well represented. In Architecture, there are drawings of many important works, such as the Westminster and Liverpool cathedrals, and also a large number of illustrations of Civil Architecture.

Bookbinding seems to have made a double claim upon the attention of the classifier, as the work of the binder appears both under the class of Art Workmanship and under that of Typography, Books, and Bookbinding. Other subjects illustrated are Photography, and Decorative Lace and Textiles, Agriculture, Forestry, Fish and Game, Engineering, Electricity, Chemical and Phamaceutical Arts, Geography and Exploration, and Transport (Land and Sea).

The author (Sir Isidore Spielmann), it will be remembered, read a paper before the Society of Arts on March 1, 1905, on "The British Art Section of the St. Louis Exhibition."

The County Gentleman's Estate Book, 1906. London: The County Gentleman's Association, Limited, 24, St. James's-street, S.W.

The Estate Book—to give its shorter title—contains a mass of information necessary to the proper conduct of an estate. Not the least valuable chapter is that which deals with "Work on a Small Farm," written by Mr. William E. Bear. A well-known definition of a small holder represents him as a person who does the work of two men for the wages of one, and Mr. Bear agrees as to the work done by the small farmer. As a rule such a man works much harder in regular hours than a hired labourer, and, in addition, has a multitude of "chores" to do early and late. Mr. Bear alludes to the town notion that poultry rearing is an easy occupation. As a matter of fact, in proportion to the profit to be earned by it, it is more arduous in respect of the time and attention required than almost any other branch of rural industry. A good deal of useful information is contained in the chapter on "England and her Colonies," though it would hardly be looked for in an Estate Book, and there is a good deal about forestry that landowners might usefully bear in mind. An article on "Some Principles to Consider in Valuing Fruit Plantations," by Mr. Cecil H. Hooper, will repay perusal. Here the question of compensation is of the knottiest.

Our Waterways. By Urquhart A. Forbes and W. H. R. Ashford. London: John Murray.

The primary object of this book is to supply those interested in the question of inland navigation as a branch of the science of water conservancy with a concise account of the historical developments and present conditions of our inland navigation system, and to examine the merits of the schemes suggested for improving and extending it by means of nationalisation, a system of canal trusts, or extension of the powers of the Board of Trade. Its value for purposes of reference is enhanced by appendices comprising lists of the principal lakes and rivers, and of the canals and river navigations of the United Kingdom, and a chronological list of the statutes, grants, and letters patent relating to rivers. It is accompanied by a map of the United Kingdom, showing the water-shed areas, and the portions of them which have been utilised for purposes of navigation.

The authors are in favour of the nationalisation of water-ways, contending that the primary expenditure, which must be large, might be made by the Government inviting a loan for the purpose of purchasing the canals, an outlay that would speedily be amply prepaid by the great incentive given to commercial enterprise. Not only would facilities for trade be largely increased by doubling our means of communication, a profitable opening would be possible, as General Rundall has pointed out, "for the disposal of some of the amount of capital now seeking investments, and a new and additional field of employment would be opened to the labouring and industrial classes who are now struggling to obtain even a bare subsistence for themselves and their families."

The authors submit abundant evidence to show that canals, even in their present condition, can be made remunerative. The nationalisation of our inland navigation system was strongly advocated before the Select Committee of 1883, while the recent proposals for its adoption made by the Associated Chambers of Commerce were only abandoned in favour of those for establishing a canal trust on account of the difficulty of persuading Parliament to provide the necessary funds for carrying it out. The authors recall that the ownership of canals by the State has produced successful results in India and throughout the continent of Europe, and it is hard to see why it should not prove equally successful in the United Kingdom, where the Government—which already owns the Caledonian and Crinan canals in Scotland, and various waterways in Ireland—earns a handsome revenue from its management of the post office, telegraphs, and telephones, and encourages municipalities to undertake that of tramways, gas, and water supply. The internal communications of a country, whether by water, rail, or road, which traverse it from one extremity to another, unimpeded by county, municipal, or parish boundaries, can only be efficiently managed on national lines, and the inadequacy of our inland navigation system, like that of our railway system, is largely due to the tendency to regard all such questions from what may be termed a parochial rather than the national point of view.

GENERAL NOTES.

Lace Openwork Hosiery.—In his report of the Consular District of Leipzig (No. 3563, Annual Series), Consul-General Baron von Tauchnitz says that amongst the villages of the district engaged in making hosiery, Thalheim has begun to take a unique position. It has become the centre of an almost separate industry—lace openwork hosiery. About six years ago, large machines, making 12 to 18 legs of lace stockings simultaneously, were first constructed, and regarded with much scepticism. It was doubted whether so complicated a machine could be practically operated on a large scale, and furthermore, whether a demand for sufficient quantities of so fancy an article could be developed so as to render operations on a large scale feasible. Both points have been vindicated, and to-day the village is largely employed on those goods, one mill alone turning out about 9,000 dozens lace stockings every week. A class of skilled operators has grown up in the village, and these can command good wages—£1 10s. to £1 15s. a week. This lace merchandise, being produced at popular prices, is now largely consumed in all civilised countries, more especially in the United States. The popularity of hand-embroidered goods has resulted in a large advance in wages, by which female labour, especially in the villages, has greatly benefited.

Nickel in New Caledonia.—It may be gathered from the report of Mr. Consul Brophy (No. 3548, Annual Series) that the high grade nickel ore exported from New Caledonia, is becoming exhausted. It is true that nearly 27,000 tons more of nickel ore were exported in 1905 than in 1904, mostly from Thio and the Eastern ports, the mines on the West coast at Neponi and Voli having been shut down, but the Consul is of opinion that it will be difficult in the future to maintain shipments of so high a grade, and its reduction to about 6 per cent.—last year the average was 7 per cent.—may be expected. The quarrying, so to speak, as the works are now in the open, is comparatively easy, but the appearance of the ore being very deceptive, even to the most experienced eye and touch, careful assays have to be made at almost every step. When nickel first began to be mined for in New Caledonia by British companies they paid attention only to the green ore, averaging at least 12 per cent., and threw away as rubbish the brown oxides of much higher quality.

Adrianople.—The present condition and outlook of trade in Adrianople show how the extension of the railway system of a country may divert trade, and so prejudice particular cities. The trade of Adrianople is declining, and has declined largely during the last twenty years, and this is due in considerable degree to the completion of the railway, in 1886, between Constantinople and the West. Before the construction of this railway, the town of Adrianople was an important centre, and was the headquarters of the trade of the vilayet, and many travellers stopped there, and the town was in a generally flourishing condition. The advent of the railway, of course, brought many advantages and conveniences, but not in the way of commerce. People who formerly would have turned naturally to Adrianople for supplies of every kind, now get them from Constantinople, which is at a distance of only eight hours by the express trains. Thus Adrianople tends rather to increase the trade of Constantinople than to keep up a first hand

communication of its own with foreign countries. The merchants generally buy in, and import from Constantinople, and confine themselves to a retail business. In the same way, the local commission agents are rather sub-agents of those in Constantinople, than independent men ready to do business with foreign firms, though, of course, there are exceptions. The British Consulate at Adrianople was only just re-opened last spring, after being closed for twelve years. Mr. Consul Townshend's first report (No. 3545, Annual Series) was issued last week, but he is without full figures and statistics of recent years, so that necessarily it is very incomplete.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock :—

May 23.—"The General Supply of Electricity for Power and other Purposes." By James N. Shoolbred, B.A., M.Inst.C.E. Sir William H. Preece, K.C.B., F.R.S., in the chair.

Indian Section.

Thursday afternoons, at 4.30 o'clock :—

May 24.—Major Percy Molesworth Sykes, C.M.G., H.B.M.'s Consul-General and Agent to the Government of India at Khorasan, "The Parsis of Persia." The Right Hon. Lord Curzon of Kedleston, G.C.S.I., G.C.I.E., will preside.

Applied Art Section.

Tuesday Evening, at 8 o'clock :—

May 29.—"Glass Cutting." By Harry Powell.

⁂ This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

George W. Eve, "Heraldry in Relation to the Applied Arts." Three Lectures.

Lecture II.—May 21. — Imaginary animals—Unicorns—Griffins—Dragons—Heraldic birds. *The Crest*—Its character and composition in tournament usage—Artistic treatment in representation—Tournament fashions in war—Difficult crests and how to treat them. *The Helm*—Its construction—Position and treatment in heraldic groups—The helmet or small helm—Its mechanism—As an indication of specific rank—Barred helms. *Mantling*—Its evolution from simple drapery—Its special value in heraldic composition — Colour treatment — Surface decoration—The torse.

Lecture III.—May 28.—The heraldic group, or achievement of arms—How proportion is influenced. *Supporters*—Their derivation — Satisfactory proportion—Their pose in relation to the other armorials and to the containing spaces—Other accessories—Crowns and coronets—The use of the cap—Insignia of knighthood. *Badges and Devices*—Their suitability to present decoration—Royal badges—The Union badges—Badges of the Prince of Wales. *Banners*—Proportion — Arrangement of the bearings — The Royal banner – The composition of the Union Jack—Schemes of decoration—Certain tendencies in modern heraldry—The study of good examples—The spirit of the old work—Conclusion.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George W. Eve, "Heraldry in Relation to the Applied Arts." (Lecture II.)

Geographical, University of London, Burlington-gardens, W., 3 p.m. Annual meeting.

British Architects, 9, Conduit-street, W., 8 p.m. Mr. P. Waterhouse, "London Traffic Commission Report."

Medical, 11, Chandos-street, W., 8½ p.m. Annual Oration.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Colonel G. Mackinlay, "Biblical Astronomy. Part II. The Morning Star."

Tuesday, May 22...Royal Institution, Albemarle-street, W., 5 p.m. Prof. William Stirling, "Glands and their Products." (Lecture III.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Admiral Sir Charles Campbell, "The Organisation of a Modern Fleet of War—Conduct in Action, &c."

Wednesday, May 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. James N. Shoolbred, "The General Supply of Electricity for Power and other Purposes."

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

Thursday, May 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Major Percival Molesworth Sykes, "The Parsis of Persia."

Linnean, Burlington-house, W., 3 p.m. Anniversary Meeting. President's Address.

Royal Institution, Albermarle-street, W., 5 p.m. Prof. W. J. Sollas, "Man of the Glacial Period." (Lecture I.)

Electrical Engineers (at the House of the Society of Arts), John-street, Adelphi, W.C., 8 p.m. Annual Meeting.

Friday, May 25...Royal Institution, Albemarle-street, W., 9 p.m. Dr. Leonard Hill, "Compressed Air and its Physiological Effects."

Clinical, 20, Hanover-square, W., 8½ p.m. Annual Meeting.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

Saturday, May 26...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Sir James Dewar, "The Old and the New Chemistry." (Lecture II.)

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FRIDAY, MAY 25, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 28, 8 p.m. (Cantor Lecture.) GEORGE W. EVE, "Heraldry, in Relation to the Applied Arts." (Lecture III.)

TUESDAY, MAY 29, 8 p.m. (Applied Art Section.) HARRY POWELL, "Glass Cutting." This meeting will be held at the Whitefriars Glass Works. A few tickets still remain. Each member is entitled to apply for one ticket, which will be transferable. No one can be admitted without a ticket.

CANTOR LECTURES.

On Monday evening, 21st inst., Mr. GEORGE W. EVE delivered the second lecture of his course on "Heraldry in Relation to the Applied Arts."

The lectures will be published in the *Journal* during the autumn recess.

INDIAN SECTION.

Thursday afternoon, May 24; The RIGHT HON. LORD CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., Vice-President of the Society, in the chair.

The paper read was "The Parsis of Persia," by MAJOR PERCY MOLESWORTH SYKES, C.M.G.

The paper and discussion will be published in the number of the *Journal* for June 8th.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, May 1st; SIR THOMAS FOWELL BUXTON, Bart., G.C.M.G., late Governor of South Australia, in the chair.

The CHAIRMAN said it was not necessary for him to say many words in introducing the reader of the paper, but he could not refrain from saying what a pleasure it was to him to meet the author on that or any other occasion. It brought back to him the memory of a very happy time spent in Australia. Mr. Jenkins, as a former minister, and as the Agent-General, was well able to instruct them in all things connected with Australia.

The paper read was—

SOCIAL CONDITIONS IN AUSTRALIA.

By HON. J. G. JENKINS,

Agent-General for South Australia.

Before proceeding with the subject of my paper I wish to thank Sir Thomas Fowell Buxton for so kindly consenting to preside. It was my privilege to be one of Sir Thomas's ministers for some years in Australia. During his residence with us we all fully appreciated the deep interest he took in every subject relating to the welfare and advancement of the country. It has been a pleasure for me to find that his interest in Australia is unabated, and that he is ever ready to assist with his time and his knowledge in making that far-off land better known.

In dealing with the social conditions of a country there are two points of view from which the subject might be considered. It might be dealt with from the general welfare of the people, or from what is known as social distinction in society. This last aspect of the question can be disposed of in a few words so far as Australia

is concerned. The people mostly belong to the great class of honest industry in one form or another. There are a few in two grades that might be classed outside this general definition. They are those who toil not, neither do they wish to toil, so long as they can beg from or loaf upon their fellows, and those who have an over-abundance of money, and vainly imagine that being industrious is degrading, so they spend their time trying to find out how to enjoy themselves in idleness. These two classes, I am pleased to say, are few in number. The great majority are, if necessity requires, willing to undertake almost any kind of work, while those who are wealthy, with but few exceptions, prefer useful or philanthropic employment to a life of idle dissipation.

Adverse Comments.

Since my arrival in England I have read letters from those who claim to be conversant with Australian life ; some of them have been so filled with statements contrary to fact, that I may be pardoned for briefly referring to them. One writer stated that many of his old friends who went to Australia years ago were tramping from place to place in abject poverty, and were most anxious to return to England if they could only get the necessary money. Then, to make his picture of misery complete, he stated "there were no workhouses in Australia." If this writer's friends have been tramping for years without getting work, they have been no doubt following the occupation they liked best and are most suited for; but no honest, sober, industrious man has had any necessity to remain for years in that unhappy position. The statement that "there are no workhouses," while in a sense true, was evidently made with the object of implying that people when unable to procure work were really left to starve. Such a suggestion is a wicked fabrication. In no country is there less real poverty than in Australia, or better and more systematic organisation for dealing with those few who are in need of temporary assistance. No one is ever knowingly allowed to suffer for the want of food. The State does not consider it to be its duty to find employment for all those who may be out of work, but in the interest of humanity it always provides food for those in want of it.

Self-Support.

It has been said that the happiest people in the world are those who can live upon the products of their own country. Australia offers greater inducements for such happiness than almost any other land. Cattle and sheep, pigs and poultry, all kinds of grain, vegetables of every variety, and nearly all known fruits are easily produced by properly applied industry. If tastes more extensive and artistic need to be gratified, the millions of pounds' worth of mineral wealth which is annually produced can be readily exchanged for such superfluities as are deemed necessary.

Primary Production.

Some weeks ago, in a paper which I read before the Royal Colonial Institute, I pointed out how great the primary production of Australia is in comparison with other countries. Sir George Sydenham Clarke, in his comments upon it, said: "It may be taken as certain that where the averages from primary production stand high the country is a good one." This has such a direct bearing upon the condition of the people that the comparisons are most interesting. According to population the primary production in Australia is about 40 per cent. greater than Canada, 57 per cent. greater than the United States, twice as great as France, three times as great as England, and over four times as great as Russia.

The productive nature of the soil and climate has a great deal to do with the fact that a greater number of people in Australia, according to its population, enjoy more of what should be known as the comforts and pleasures of life than is the case in many other parts of the world. Take the people as a whole they are better housed, better fed, and better clothed than the residents of most other countries. There are, of course, cheap houses and discomforts, but even in the Australian cities there is a lack of the poor shanties and tenements, with their squalor and filth, which is so noticeable in many large cities in other countries.

Educational Advantages.

No one question has a more important or direct bearing upon the social conditions of the people than that of education. I have been frequently asked by those who contemplated settling in Australia what the facilities are for their children's education. My answer has always been that no country has better facilities, and but few as good, and that with the exception of some parts of America Australia affords as good an oppor-

tunity for secondary and advanced education at a moderate cost as any other country.

Generally speaking, the system of public education is free, compulsory, and secular, the whole expense being met out of the general revenue. The greatest care is taken to provide schools in every part of the country as well as in the thickly populated cities, and in some of the thinly settled districts, schools of from ten to fifteen children are established. Fortunately, Australia's educational advancement has not been delayed by sectarian interference. There it is generally considered that a country's advancement rests on the education of its people, and that as national education is a national gain, the nation's treasury should meet the bill. Efforts have been made from time to time by zealous propounders of sectarian beliefs, to incorporate religious instruction with the Education Acts of the different States, but the majority of the people are strongly opposed to any form of State aid to religion. They feel that in the bitter strife for sectarian supremacy the efficiency of the schools would become impaired and the practical education of the children neglected. The parents generally take advantage of the public schools for their children, but for those who object, either from class prejudice or religious scruples, good private schools are available.

The technical schools, colleges and universities afford ample facilities for higher education. The Australian universities stand high in the educational world. By bequests, endowments, and grants of land they have been enabled to provide splendid buildings and appliances, and to procure able and learned professors. The degrees conferred are recognised and respected in other lands. No one need leave Australia to become well versed in music, medicine, literature, law, or science. The technical schools have been most valuable, especially from a mining point of view, and many of those who have received their instruction there are now holding important positions on mining fields in Australia and other countries. Nearly 1,300 public libraries with 2,000,000 volumes of valuable literature are a great help to those who have passed on beyond school life. In all the principal cities there are public museums and art galleries, which are largely patronised, and have an elevating and refining influence.

During the past few weeks the education question has been freely discussed in connection with the Bill now before the House of Commons. It is not my intention to, in any way, touch upon debatable politics. Of the merits or demerits of Mr. Birrell's Bill I express no opinion. The discussion, however, has gone beyond the limits of the Bill. Australia has been pointed to as a fearful example, to be avoided. Crime is said to be on the increase as the result of the educational system, and the morality of the people has been assailed.

As one who for many years held positions which gave me a direct knowledge of every section of the community, as an ex-Minister of Education, and, to a certain extent, responsible for extending and maintaining the present sysem, I wish to give the most emphatic denial to these malicious untruths. I shall not at present go into detail in reference to these aspersions on Australia's fair name. The statistical record of the country will show how unfounded they are.

Religious Instruction.

Just now I referred to the non-sectarian nature of the public schools. The religious instruction of the people, however, is not neglected. Churches of every known denomination are supported. Many able preachers are devoting their lives to the spiritual advancement of their respective flocks. Sunday schools, Christian endeavour societies, and young men's and young women's Christian associations are well attended, and all doing good work, while the Salvation Army has its branches stretching over every part of the land, and is to be commended for its tireless endeavours to reclaim the drunkard, lift up the oppressed, and to bring back to the paths of virtue and truth those who have strayed or fallen by the wayside. Temperance organisations of various kinds have many members, and are a powerful factor in preserving the better, simpler, and purer life of the community.

Government Institutions.

The Governments of the different States look after the poor, the sick, and the afflicted. They have destitute homes, where the aged are properly housed, fed, and cared for. They have hospitals for the sick, where those who cannot afford to pay are nursed and attended equally with those who can. Asylums for the insane, sanatoriums for the consumptive, while homes for incurables, and schools for the blind, deaf, and dumb are either supported or subsidised by the Governments. There are no workhouses, it is true, such as are used here, and I hope the time will never come when

there will be any necessity for them. Genuine working men, if unable to obtain employment, are allowed to do certain work to pay for the food which is provided for them and their families. Such relief is of a temporary character until more permanent employment is secured.

Frugality and Moderation.

Benefit societies and insurance companies have been established in every State, and number their members by many thousands. These have a marked effect upon encouraging provident habits, and, with the temperance societies, are valuable aids in teaching frugality and moderation, which are such notable characteristics of the Australians.

Some of the States have adopted a system of old-age pensions, and a Royal Commission has recently reported favourably on a scheme for the whole Commonwealth. As it means a heavy increase in expenditure, the Government may follow the illustrious example of the Prime Minister of England, while dealing with payment of members, give the question full sympathy, and agree with it in principle, but for want of funds indefinitely postpone any action.

Out-door Life.

To those who are fond of an out-door life (and most people are, if they only had an opportunity of indulging in it), Australia is unsurpassed. The climate is such that you can practically spend the whole year outside. The advantages of fresh air have been wisely considered by those who had to do with laying out cities and towns, as well as those connected with the government of the country. Wide streets, squares, and parks are to be found in and adjacent to all the cities, while large tracts of land have been reserved as national parks within a few miles of the centres of population.

Games and Sports.

This affords every opportunity for out-door sport of all kinds to be carried on, and it is on these grounds, so wisely preserved, that some of the Australian Elevens first commenced their future careers by protecting or bowling the harmless kerosine tin. Rowing, football, cricket, lacrosse, golf, baseball, and almost all other outside games have numerous patrons. In fact, games and sport are carried on so extensively that tourists have criticised Australians for indulging so much in them. Numerous holidays, reasonable hours for work, and long, fine days offer every inducement. There appeared so much play to Mark Twain when he was there that he said "every other day was a holiday, with a horse-race between." Australians are decidedly a sport-loving people. The Melbourne Cup is one of the world's greatest racing events, and it always appears to be held when meetings of a social nature happen to be taking place in Melbourne. The Governors of the different States about that time arrive at the conclusion that matters of grave importance require their consultation with the Governor-General. Premiers and Ministers of the Crown sometimes discover that important State matters necessitate a conference in that southern city. Business men from all quarters think it a proper time to attend to their affairs. Of course they do not go to Melbourne to see the Cup, but, being there, they think they might just look in, to see the crowd as it were. The Australians love good horses, and the motor-car has not yet driven that noble animal from the field. While the horse still holds a high place in the matter of travel, the roads are so well made that motoring and cycling are greatly indulged in. Many residents own motors, and during the last few years money has become so plentiful that vehicles for pleasure have been purchased in large numbers.

Wealth of the People.

It is not generally known that the Australians are the richest people in the world, except the residents of England, and a good many of these draw their incomes from Australian investments. During the present year Australia will export produce of greater value than ever before; whether this will bring her average wealth according to population up to England I cannot say, but a few more years of such growth in production certainly would. The wheat yield of Australia last year was between 60 and 70 million bushels. I have not the complete figures of the probable export, but from my own State, South Australia, after providing all that is necessary for the local consumption, and retaining sufficient to sow 2,000,000 acres, they will still have enough for export to England to provide nearly 4,000,000 people with all the "big" and "little" loaves required for the next twelve months.

The distribution of wealth is more general in Australia than in most other parts of the

world. Over 30 per cent. of the adult population are possessors of property, while in England only about 12 per cent. of the adult population enjoy that privilege. There are 1,100,000 depositors in the savings bank, being 27 per cent. of the entire population, and they have to their credit £36,000,000, an average of £33 each.

A Good Place to Reside in.

Let me enumerate a few of Australia's advantages as a place of residence. The death-rate is lower, the primary production is greater, the wages are higher, the standard of living is better, the houses are more substantial and surrounded with more land, the hours of labour are shorter, telegraphic communication is cheaper, the weather is brighter, the laws more liberal, the wealth more evenly distributed and class distinctions fewer than in almost any other country.

Besides all this Australia, in the matter of language, is more English than England. You can hear more foreign languages spoken in London in a day than you can in Australia in a year.

Alien Immigration.

We have been blamed for being rather restrictive in our dealing with aliens; restriction has its advantages. Even England has arrived at the conclusion that by throwing its ports open to all undesirables, and calling itself "the home of the oppressed," many of the oppressed from other nations soon become the oppressors of her own people. The crushed and persecuted of a continental country have sometimes developed in England and America into the tyrannical employer and mercenary sweater.

Administrative blundering gave undue prominence for a time to the provisions of the Australian immigration restriction laws, while laws equally restrictive in other countries have but little attention paid to them.

Laws and Socialism.

Generally speaking, Australian laws are liberal and progressive. It is, however, a mistake to think that the country is being ruined by rabid socialists. There are a few irresponsibles who do much damage to their own and their country's credit by foolish talk and absurd proposals. The Press, ever ready for good copy, gives them a prominence far beyond their real importance.

Taking an active and responsible part in the management of national affairs has a moderating and modifying effect upon most politicians. From a personal acquaintance with many of those who have been Ministers of the Commonwealth or State Governments for several years past I have noticed in nearly every instance that they have fully recognised the responsibility of office and endeavoured to safeguard the country's interest. This course has been followed even when severely criticised by members of their own parties for acting in opposition to some of their past utterances, made when they were free from administrative responsibility.

A Broad Franchise.

The voice of the people can be made fully known through the ballot-box. The judgment of the public may not always be considered the wisest for the country's advancement, but when the error is discovered the same power that caused it can apply the remedy. The Australian Commonwealth franchise is the broadest and most liberal possible. Everyone over the age of 21 (except criminals and lunatics) has the right to vote. In some of the State elections as well, women have the privilege. There were many strongly opposed to woman's franchise. All the arguments about taking her from her home, destroying her womanly instincts, causing her to neglect her proper duties, &c., were indulged in. After the law was passed, however, those who previously opposed it, quickly realised (especially if they were parliamentary candidates) that woman was highly intelligent, and that it was her duty in the interest of the country to vote, and of course they explain for whom she should vote. I contested three elections in South Australia after the introduction of woman's franchise, and having been returned with large majorities on each occasion, I never had reason to doubt the wisdom of women voting, or the intelligent manner in which they exercised that privilege.

Socialism, a National Development.

Australia's Socialism has grown with her people. It has not meant the destruction of private property. The State railways, harbours, waterworks, telegraphs, telephones, wharves, exporting departments, public schools, and other undertakings, have naturally followed one after the other, and have not been a hardship to the capitalists, but have rather been the means of allowing them to invest

their money in other undertakings, and thereby assist in opening up the pastoral, agricultural, and mining industries.

Assistance to Producers.

Many of Australia's laws have been passed on the understanding that the Government could undertake certain things for the assistance of the people at less expense than this assistance could be carried out privately. National credit, as a rule, is much better than individual credit. Money can be borrowed by the State and lent to producers on better terms than it can be borrowed by private people for that purpose. I do not mean that any applicant can go to the Government and obtain what money he chooses to ask for, but under certain laws the well-to-do pastoralists, as well as the poorer producer, can be assisted. You may ask what need to assist the pastoralists. It is necessary to understand Australian life to realise the need for this. The Governments own most of the land ; hundreds of miles of this is let on lease to pastoralists. Wire netting has been found to be the most effective means of protecting the sheep from wild dogs, and of keeping the rabbits down. For the lessee on his own account to undertake to fence his leasehold would mean an expense which would be a heavy burden upon him, and prevent the use of his capital for other improvements ; so by combining with adjoining lessees they form a vermin trust, and apply to the Government for miles of wire netting ; this is supplied upon the joint security of the lessees ; and they pay the Government back, with interest, in instalments extending over a number of years. Large sums have been lent in this way, and, so far as I know, no loss has occurred, and it has been the means of stocking much land that would otherwise have remained idle. The Governments also assist the farmers by loans from State Banks at low interest, a long term of years being allowed for repayments. Blockers, who only have a few acres, are also assisted, and under certain conditions they borrow from the Government to help to build their houses and carry out other improvements. All these loans are only granted on business principles, after the officers of the Land Departments have made full inquiries as to necessary security. The Governments also largely assist in exporting produce and finding outside markets. This business is conducted on commercial lines, certain charges being made for the storage, freezing, and work done. If the producer is in need of ready money before his goods are disposed of an advance is made by the Government. All this may be considered Socialism ; however, upon a moment's reflection it will be seen that it is only an assistance to further stimulate individual enterprise and effort. It has carried many a struggling producer over early years of hardship, and probably saved his property for his family when under other circumstances it might have gone into the hands of the mortgagee.

Ruining the Country.

We often hear the expression that certain parties are ruining the country ; that expression is applied just now, perhaps, more frequently to the United Kingdom than it is to Australia, and there are those who say that it is more truthfully applied here. The most difficult country to ruin is the one where the earth gives forth the greatest wealth. You can destroy a broking or banking institution ; you can allow unequal competition to ruin large manufacturing establishments, but it is more difficult to destroy or even check the productive properties of the earth. Unjust laws may drive the producers from their work, but others come to take their places, and if unable to live under the old laws, new ones are made. All legislators are liable to err and hastily pass laws that have a different effect from what was anticipated ; but new countries quickly see their mistakes and remedy them. No sensible property-owning, peace-loving, industrious people would be likely to pass or enforce laws that would permanently injure or destroy their own country. Australians must live under their own laws. Is it not, therefore, reasonable to suppose that they are as conversant with their own requirements as those clever people at this end of the world who so frequently criticise the legislators and the laws of the lands beyond the seas, when they are entirely unacquainted with the conditions which may have prompted them ?

Speculation and Industry.

Australians have been accused of being too speculative, and told that speculation kills industry. This last statement is not altogether borne out in fact. They may be a speculative people ; the climate and the country encourage it. There is greater speculation in pastoral or agricultural pursuits than many suppose. In many parts of the country one is fairly sure of good crops, but in other parts one is not so certain, and the speculative farmer

backs his opinion on the providential chances of rain, and sows large areas. If rain falls in due season he does well, if not, his time, seed, and expense are gone. The same applies to a greater extent with the pastoralist in some localities. A few good years mean a fortune, a few bad ones, perhaps, bankruptcy; while with mining we all know—most of us to our sorrow—how speculative it is. Owing to this speculative spirit, which, in a measure, has been made necessary by conditions, Australians have been called gamblers. The term is hardly applicable. A real gambler is said to expect something for nothing; Australians take their chances on the elements for a large return for their toil and expenditure. They are not easily discouraged, and from what I have already said, take them as a whole, they are well provided with this earth's goods.

There are those who never acquire wealth, but are always going to; their optimistic natures are a cheerful asset for any country. So long as their health and strength hold out they keep going, fully determined to meet, or overtake, a fortune somewhere on life's journey. Their presence in a community is of far greater value as a stimulating force than the despondent pessimist, who worries everybody for years while he is making money, and then worries them more than ever during the remainder of his life for fear he will lose it.

Charges, Rates, Taxes.

Railway charges are, if anything, less than on the roads owned and worked by private companies. The conveniences for travelling are good. The Government control of waterworks and sewage systems for the large cities has proved economical and satisfactory. The land-tax is not heavy enough to be burdensome. Municipal and local rates are low in comparison with this country. The rates, all told, in the Australian cities, including water rates, on property worth £100 per annum, would be from £10 to £20, while in and around London it would be from £30 to £60. So on the question of local taxation the Australian has much to be thankful for compared with those who own or rent houses in this country.

Employer and Employee.

Generally speaking the relations between the employer and the employee are harmonious; occasionally disputes may arise, but they are nearly always settled without those long strikes which result in heavy loss to both resisting forces, and engender so much bitterness of feeling. The employers as a rule pay good wages, the hours worked are short, and the employees are provided with favourable sanitary and safety conditions. Being thus satisfied that their treatment is just, they in their turn do their best to give full value in their work for the wages they receive. There are drones, of course, in Australia's hive of industry as well as in every other part of the world, but they are not over numerous, and the industrious workmen think as little of them as do the employers. They are either compelled to become more alert in their movements or join the army of unemployed wasters, a type of person known in every land, as always looking for work, yet haunted with an apprehensive dread lest they find it.

No Ostentatious Millionaires.

The distribution of wealth being so general, the two extremes of great wealth and abject poverty are not so marked as they are in Europe or America. There are no ostentatious and vulgar millionaires wasting thousands of pounds upon extravagant dinners to a dozen over-fed and perhaps over-drunk individuals as is done in some countries, when the amount spent on each guest would have given a good wholesome meal to a thousand of those in need of food. There is nothing more calculated to spread Socialistic ideas of the most revolutionary character than the purse-proud individual who often, through no effort of his own, suddenly becomes rich, and in a lofty and superior manner makes a lavish display of his wealth. There is no poison without an antidote, and in many cases the Socialist has the satisfaction of seeing the wealth of these individuals divided by liquidation, in the dual sense of the term.

Literature, Art, and Song.

I once heard the editor of a paper make the statement that you could always judge of the happiness and intelligence of a people by the number of newspapers they read. Most of us are not in the habit of taking all editors' remarks, either oral or printed, as gospel, yet there appears a certain amount of truth in this one, for, according to Mr. Coghlan, who is a statistical authority, Australia has as large a number of first-class newspapers, considering its population, as any other country in the world, while in the matter of letter-writing the

only two countries that surpass it are the United States and England.

That Australians have a taste for literature cannot be denied; what they read may not all be of the highest standard, and what they write may sometimes lack artistic finish, but we must recollect that it is comparatively a new country. Its real growth has taken place during the last fifty years. Other countries have not risen rapidly to literary fame. The first settlements of America were made two centuries before the world had the benefit of Irving, Longfellow, Emerson, or Lowell. England's men of letters were not numerous or renowned until many generations had passed away. No one knows what a country may bring forth, or when a bright star may appear. Even now some crude cradle in the back blocks of the Sunny South may be rocking a crabbed child who is to develop into an Australian Carlyle. By an Australian brook, that does not run on for ever, some poetical Tennyson may at this moment be happily playing with mud pies or pebbles, while on a sloping hillside some famous novelist of the future may be lying in the afternoon's sun blinking his eyes in infantile imagination, and what could be a better augury for a great novelist than to commence by lying wherever it happens to be?

While in literature Australia may not up to the present have produced writers of marked distinction, yet there are those of more or less note whose productions are of no small merit, and who have thrown the bright sunshine and free life into their work. The same may be said of art. While no one person stands out as a producer of a £3,000 picture at "Christie's," there are several who have the true artist's spirit, and in the centuries to come "Christie's" descendants may unearth from some unknown lumber room pictures that will bring fabulous prices, while those artists of this century who produced them may have had a hard task to procure even the necessaries of life. But when we come to musical artists Australia has no need to feel ashamed. An observant American once said that he never visited a country where the sunshine was brighter, the sky bluer, or the voices of the people purer, clearer, or sweeter. With these conditions it naturally follows that those who are musically inclined have succeeded; and to-day, according to its population, Australia is reported to have more prominent musical talent of world-wide reputation than any other English-speaking country.

Society in Brief.

If time permitted I might for a few moments deal with the social conditions of Australia from the society point of view. Each Australian city and town of any importance has its "season." Therein they copy this great centre of fashion. During the winter, dinners, balls, receptions, at homes, musicals, theatre, and card parties, are all carried on. In the spring, strawberry fêtes, garden parties, picnics, &c., are in order. Then as the hot weather approaches, in some places the fronts of the houses are closed, blinds put down, shutters put up, and the families move away to the seaside or country. There, too, you see they are again copying fashionable London. Travelling and hotel accommodation is good, and the railway porters and waiters are attentive and obliging, always assisting one with a keen expectancy of favours to come. Some of the restaurants and clubs have even copied London so far as to put up notices "no tipping allowed." This is observed there, as it is here, by tipping silently.

I have only briefly mentioned these things so that one can see that the surroundings are suitable for all who desire to emigrate, and that no one need become homesick for the want of some of those privileges they may have been in the habit of enjoying here.

Character and Industry.

Perhaps there is no country where man's manhood and character are more fully recognised than in Australia. High recommendations, and the great deeds of some remote ancestor may serve as an introduction, but unless the holder of these distinctions proves himself to be able, industrious, and reliable, he will not, as a rule, find the surroundings congenial for his permament settlement.

Duty to Give Information.

Australia has a large extent of territory, very sparsely settled. It is asking for more population, and if we induce people to break up their homes here and emigrate to that distant land, it is our duty to make them as conversant as possible with the productiveness of the country to which we ask them to go, and with the conditions of life that would surround them after their arrival.

Time will not permit me to deal more extensively with this subject at present; I have tried to avoid wearying you with too many statistics. My object has been to place before you a few plain statements concerning Australia, and if

possible to assist in making the productiveness and wealth of that country and the condition of its people better and more favourably known.

DISCUSSION.

The CHAIRMAN said it was always difficult and dull to refer to the ninety per cent. of features in which colonists and their lives were similar to those at home. The tendency was to dwell with more emphasis upon those points where differences existed. Sometimes papers which dealt with these differences left the impression on the audience that everything had been said, whereas, the greater part of life in the colonies closely resembled life at home. Mr. Jenkins had used the words "primary productions" He (the speaker) would have liked to have a little clearer definition of what these primary productions were. He supposed they were wheat, food, and raw materials. Well, even they were open to strange changes. Only that afternoon he had been at a committee where shipping interests were under discussion; and it was stated by one or two who had intimate acquaintance with the subject that until recently there had been a considerable trade in wheat, mostly in sailing ships from the coasts, from San Francisco round Cape Horn to England and Europe, and that, even before this devastating earthquake took place, there were signs of the trade coming to an end within a very few years—four or five—partly because the quantity for export would be less by the filling up of the country, and partly because a greater variety of products would be raised. Another curious change was stated to be that until recently there was a very large trade in coal from Newcastle just north of Sydney to San Francisco, Tacoma, and adjacent coasts, and that it had been killed by the increased use of oil as fuel. He had no doubt that changes would be found even in the primary productions in Australia. Allusion had been made to a subject that was rather prominent in 1895 in South Australia, and had been occupying the public mind at home lately, viz., the reading of the Bible in public schools. Why should it be right to teach the children, it might be quotations from Chaucer or Shakespeare, or from the translation of the Greek of Homer, and yet debar them from the writings of St. Paul? Both in Australia, and here, he took it that those questions were not finally settled. In Australia it might be settled for the moment, but had not yet reached its final solution. With reference to the mining part of Western Australia, one curious fact came to his knowledge, namely, that Americans were so largely in demand for the higher managing posts. The appearance of the country had no doubt been greatly affected by the use of bicycles on the roads. He thought this had had one rather unfortunate effect, it had greatly tended to put an end to the habit of walking. When people had good roads they naturally used their railways and roads with motors and bicycles. Even in his time he noticed how very little there was of a habit of walking away from the road. He and his family had learnt to enjoy walking in rough countries—the Alps and elsewhere, but it had not he thought occurred to the friends who joined them in the walks they took in the neighbourhood of Marblehill, and which were found to be so very delightful, to do so before. Mention had been made of the Government land system. One question was suggested which struck him when he was in Australia, and he never could quite get to the bottom of it. The Government owned the land. That was all very well. Then it lent the tenant money to set up fencing, and he thought water supply also. The English plan was for the owner to provide the land and buildings, the fences, and, generally speaking, the water supply, which might be in the form of ponds. He never could understand why that system would not be equally useful and desirable in Australia. It seemed to him to complicate things when there was a system of tenancy combined with money-lending for a special purpose. Then all care had to be taken that the money was applied as was intended, giving, it seemed to him a good deal more trouble to the Government than if it provided both the land and the amenities upon it. He thought Australia might boast itself on the charms it had for those socialistically inclined. But also, in a certain way, those who were aristocratically inclined found some sympathy. As with the colonists in Canada, those in Australia were quite as ready to adopt an aristocratic hauteur and pride and a stand-off attitude when they were dealing with certain nationalities. Even Europeans, unless well endowed with ability as farmers, and with capital in their pockets, were not made very welcome.

The Hon. Sir JOHN A. COCKBURN, K.C.M.G., said it was a great pleasure to him to find himself in association once more with his own chief, a former Governor of South Australia, Sir Thomas Fowell Buxton, and his old colleague, Mr. Jenkins, a former Premier of South Australia, who had given them a racy and charming account of the Australian people. He himself was never weary of hearing the truth spoken about Australia; and when they spoke the truth, language would hardly describe the advantages of that great country. In many parts of Australia, although the climate was temperate, they had practically no winter, but two springs, one before the summer and the other after. So great were the advantages with regard to climate that a friend of his who visited England, a few years ago, said it was a good thing for the old country that Australia was not within a week's sail. If so, this country would be depleted of a great portion of its population is a very short time. He did not think it was possible to speak of the attractions of Australia in too high a key. He had noticed in some of the old works describing Australia

the description "Australia *felix*"—Happy Australia! and he did not think that word could be applied more truly to any other country. So far as the people were concerned, they were just the same as the British people, only rather more so. They had every quality that characterised the British race, and on which the British race prided itself, only every quality was somewhat accentuated. They took life more fully into both hands, and lived their lives with greater zest. But as a rule the Australian was simply the more active British citizen. That was seen in the fact that in much of the legislation for which they had been denounced this somewhat more deliberate country was simply following in their wake. The long reign of calumny against Australia was coming to an end, for a very singular reason; because, instead of bringing accusations against Australians, English people now found plenty of time taken up in refuting similar accusations against themselves. It was very easy for people in England to challenge and criticise the administration of the Australian Immigration Act when they had no similar Act themselves in this country, and therefore could not be subjected to criticism; but many of the denunciations against the Australian Aliens Act had ceased to be uttered since there was an Alien Act here. They heard no more about the question of a shipwrecked crew being landed on their shores since in last January a shipwrecked crew was not allowed to be landed in England until the captain had given a bond that he would immediately return them to the country from which they came. As a matter of fact no shipwrecked crew was ever refused admission under the Immigration Act to Australia at all, so that they were denounced for what did not take place in Australia but had taken place here since. So with regard to the criticism about the labour party. People used to say, "Oh, you have a labour party in Australia; it is going to be the ruin of the country." That was not true, because the labour party was a very solid element in the prosperity of the country. There was nothing like giving men responsibility in order to make them worthy of that responsibility. But there were fewer criticisms in England about the Australian labour party since they had a labour party of their own. And with regard to old age pensions, payment of members, and such other socialistic legislation, they were knocking at the door of the British House of Commons too. The accentuated life of the Australian was owing to the climate. The bright sun stimulated the faculties, increased the circulation of the blood, supplied the brain with brighter arterial blood, brightened thought and encouraged action. The standard of citizenship in Australia was extremely high. They had only to look at the Australian women at the Austral Club in all their glory. The only fault was that they wanted more of these fine standards of development of men and women. Australia was now taking steps to encourage the immigration of a larger population to settle in the vacant spaces of the island continent. The more people here understood Australia the more they would appreciate that great outlying portion of His Majesty's dominions. He was sure they were all grateful to Mr. Jenkins for such a chatty description, which brought their dear home-land vividly back to memory.

Mr. OCTAVIUS C. BEALE (ex-President of the Manufacturers' Association of Australia) said it was exceedingly gratifying to him to hear Australia spoken of, as Sir John Cockburn had truly remarked, in the proper terms. When he (the speaker) was travelling through the United States it gave him the highest gratification to find that there they recognised America as a great country. Nothing too good could be said for it. In Australia there was very sharp criticism of their own people and their own land. It was very gratifying to him to hear in London people speak of Australia as his friends had done that day. There was no doubt the wave of calumny was gradually being corrected. They wanted fairness to their country, and in order to be thoroughly fair, he thought there was no use in ignoring that there were serious troubles. There were difficulties everywhere. There was no question that in Australia they were subject to long periods of drought, which had to be dealt with as a normal concomitant of the climate, to be faced and calculated for and fairly met. He could not forget that only three years ago he was one of the original trio who were engaged in collecting funds to keep the settlers then upon the soil of New South Wales in particular, although other States were suffering, and they raised some £24,000. Of course, a good many people came to them to deal with their surplus long before they had the whole of their money collected, and they were assured there was not going to be any surplus. But to their pleasure, they found they had a trifle left over after relieving all those they came in contact with. It was proposed by one or two friends that they should send to London to the wealthy Australians, not to ask them for money, but to tell them they wanted it. But it was overruled, because they might have spoilt the credit of the country. Sometimes he wished they did not have any credit. It would be a vast deal better if, having borrowed £226,000,000, out of which £46,000,000 were borrowed locally, they set themselves to reduce that other £180,000,000 by borrowing more and more in Australia. He happened to be one of the trustees of the New South Wales Saving Bank, in which they had £5,300,000 of funds belonging to the people. Now, their difficulty had been to get proper investments for their funds in Australia. In July last they received an intimation—it was polite but pretty curt—from the Government, that if they did not settle for a renewal of their £750,000 which was falling due in September they would hand it back to them. Well, they were obliged to renew it for $3\frac{1}{2}$ per cent. at par. Now Australians in London took money at $3\frac{1}{2}$ per cent.

under par, and that was one of the things that he as an ordinary man, not belonging to the *haute finance*, could not understand—why the Australian Government should want to give less to their folk than to others at the other end of the world. If money were borrowed locally at even a little more than in London —and perhaps that sounded socialistic—many thought that Australia would be greatly advantaged and would be only following the example of the United States and Great Britain. He did not believe banking arrangements would be disturbed if by some inducement, whether by low denominations of the bonds, or by any other reasonable methods, they persuaded people to deposit more of their money with the Government. He supposed that eventually the Commonwealth Government would take over the loans. As a very ordinary business man he confessed he did not quite see how that proposition was to be carried out without taking over assets too. It must be confessed that there were unemployed in Australia. There were in the State of New South Wales skilled labourers unemployed who belonged to the iron trades. Not a single ton of iron was produced in Australia. The very Kaffirs in South Africa had for a thousand years set them an example in that direction. They actually smelt iron with their charcoal. If that basic industry were successfully started in Australia—and the price of coal was lower than anywhere except in Tennessee—it ought to be good enough for someone at this end of the world to produce iron and steel in Australia, which would strengthen the British Empire more than any other proposition within his humble ken. In Australia they were between the two great oceans. That continent was the last great outpost of the British people, and of enormous importance, the noblest possession, he believed, that the British nation had—and they were endeavouring to keep that for the British people who gave it to them in trust. They could divide that continent to-morrow amongst themselves if they chose; but they did not listen to any such proposition. They perhaps made mistakes even in going to too great an extent in the opposite direction. There was no Socialism on the lines of the Fabian Society. They had very little or nothing of the communistic idea in Australia, but there was plenty of room for a great deal of honest socialism.

Mr. G. Collins Levey, C.M.G., was glad that in Mr. Jenkins's paper the State element had been completely lost in the federal element. They had heard that afternoon a great deal about Australia, but very little about South Australia, although they had the advantage of an ex-Governor of South Australia speaking. To his mind it was of great advantage that that should be so. During the time he lived in Australia a great portion of the strength of the nation was lost by the country being split up into a large number of small, or comparatively speaking small colonies. As a very old colonist he could perfectly endorse all that had been said by Sir John Cockburn. He did not believe that Australia could ever support a very dense population many hundreds of miles away from the coast, owing to the droughts to which the whole of the interior was subject; but for a population of 20,000,000 or 30,000,000, Australia had advantages, and they could be maintained in a higher state of comfort and luxury than in any other portion of the world. The climate, on the whole, was better, the wages of labour higher, the profits of business and the profits of grazing, on the whole, larger than in any other portion of the world; and he was quite sure that if Australia was as near to the mother country and to the thickly-peopled portions of Europe as Canada was, Great Britain and a very large portion of Europe would be depleted within a very measurable period of time. He did not know why, but somehow in Australia they never had the idea of walking. They were almost centaurs. They were not born on horses, but certainly lived on them. He could scarcely understand Australia being now handed over to bicycles and motor-cars. He was not at all certain that the capital in Australia was large enough for them to do without getting money from England, where there was a superabundance, and where interest on money was certainly less than in Australia. He perfectly agreed with every word that had been said on socialism. The State socialism of Australia was an entirely different thing from the theoretical socialism of this country. In Australia, what was called "State socialism" had been a matter of very successful practice.

Sir Frederick Young, K.C.M.G., said that although not an Australian, he was a Briton, and he felt everyone around him was the same, whether he belonged to the old country or hailed from that in the Southern Seas which was allied to them by every possible tie. He had been delighted with all he heard Mr. Jenkins say, both as to the charms of the country and also socialism. Like so many other words in the English language, it was liable to several interpretations; and they recognised that in England the word was associated with a certain idea in the minds of many ignorant people that was quite different from the socialism so ably described by Mr. Jenkins. He could not help feeling how desirable it was that a word of that kind should not be used merely as a shibboleth by thousands of people who knew nothing about its real meaning.

On the motion of the Chairman, a cordial vote of thanks to Mr. Jenkins was carried unanimously.

The Hon. J. G. Jenkins, in reply, said with regard to the point as to managers of gold and silver mines being Americans, that was the case ten or twelve years ago; but he was pleased to say that a great many of the managers of the mines since that time were Australians, and that the development of their

education in schools of mines in New South Wales, South Australia and Victoria, had given to the world some very able mine managers. On the question of walking or riding, so far as the Australian people were concerned, they were in the habit of getting over long distances in quick time, and for that reason they had gone in more for using horses and motors. He felt indeed thankful that he had had an opportunity of speaking in connection with the Society of Arts. He would like to say that, in looking over its records, he considered that the Society had done a great good, not only for England but for the English-speaking peoples. Practically, that Society was the cradle of technical education throughout the whole of the British Empire, and in that respect, if in nothing more, it had been the means of doing more good than it was possible then to state; for had the technical education of British people been neglected, their manufacturing interests could not have been in the state in which they were at the present time.

TWENTY-THIRD ORDINARY MEETING.

Wednesday, May 23rd, 1906; HENRY GRAHAM HARRIS, M.Inst.C.E., Member of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Babu, B. Chitti, Messrs. Parry and Co., Madras, India.
Bernays, Albert Evan, M.A., 3, Priory-road, Kew, Surrey.
Vivian, Harry Houlton, J.P., Tregavethan, near Truro, Cornwall.

The following candidates were balloted for and duly elected members of the Society:—

Brain, Charles Kimberlin, South African College School, Cape Town, South Africa.
Eranee, Pestonjee Cursetjee, Markur's-building, Apollo-street, Fort, Bombay, India.
Gobariya, Rai Sahib Pandit, Garbiyang P.O., District Almora, U.P., India.
Hoffman, Professor J. Wesslay, D.Sc., State Normal and Industrial College, Prairie View, Texas, U.S.A.
Parsons, William, Bengal Chamber of Commerce, Calcutta, India.
Robinson, Mansergh Dias, M.Inst.C.E., care of the Engineer-in-Chief, Cape Government Railways, Cape Town, South Africa.
Row, T. S. Sama, 126 Coral Merchant-street, Madras, India.
Sessionwalla, Framroz Hormusjee, Grant-road, Bombay, India.

The CHAIRMAN said he was sorry to have to announce that, owing to a sudden domestic bereavement, Mr. Shoolbred was unable to be present at the meeting. He was sure the members would deeply sympathise with Mr. Shoolbred in the great loss he had sustained. In the absence of the author, the paper would be read by the Secretary.

The paper read was—

THE GENERAL SUPPLY OF ELECTRICITY FOR POWER AND OTHER PURPOSES: ITS COMMERCIAL CHARACTER AND CONTROLLING MANAGEMENT.

BY JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

At the present time, when so much has been done in Europe and in America to provide a general supply of electricity, and almost the whole of England has been parcelled out among a number of electric power companies, there needs some explanation as to the selection of the title for this paper, and likewise as to the nature and scope thereof.

It is not intended in the following remarks to include anything of a technical character, since the many fine examples of electricity distributing stations, which exist in this and in other countries, clearly show that it is unnecessary to do so. But it does not require any intimate acquaintance with the conditions which prevail in this and in other countries respecting the supply of electricity for industrial purposes to arrive at the conclusion that, in England, the facilities, generally available, are much less than in other important countries. And this country is thereby placed at a considerable disadvantage in its commercial competition with European, American, and other markets. The object, therefore, of the following remarks is to endeavour to ascertain the cause of this backwardness in this country, while at the same time suggestions will be put forward and discussion invited thereon, in the hope of finding a remedy, whereby the want of enterprise, which prevails in this country, as to the extension of these general supplies of electricity, may be further stimulated; and at the same time, an increased confidence therein may be imparted both to manufacturers and to the general public to avail themselves of the advantages thus offered to them.

During the last few years the value, nay, almost the need, of electrical energy, in carrying out a large number of operations,

which are of almost primary importance to the welfare and interests of the community at large, has become gradually more and more recognised.

These interests may be described (1) of a *public character*, and involving not merely the sanitary, and other similar objects which are embraced under the phrase, "Electric Lighting," but also in the further facilities, afforded under the head of "traction," to enable the public to carry out more expeditiously their ordinary avocations; (2) of a *private character*, in providing the commercial and the trading portion of the community with improved methods of carrying out their various kinds of manufactures, in the transport of their materials, and in the disposal of their manufactured goods; and (3) of an almost *national character*, in providing more favourable conditions for British commercial interests, in the keen competition which is arising against us in our own as well as in foreign markets.

It is admitted that a general supply of electrical energy, laid down under favourable commercial conditions, and capable of complying with the requirements of all of the above-mentioned interests, is becoming a matter of much moment to the community at large, far exceeding the limits of the private interests of certain trading and commercial circles.

To ensure, however, the production and supply of electrical energy, under the most favourable conditions, especially as to financial economy, the clashing of conflicting interests must be avoided as far as is possible.

It is with this object that efforts have been made during the last few years, by the Board of Trade, by some of the County Councils, and also by some of the more important users of electrical energy, to endeavour to obtain uniformity, especially on two points, viz.:—(*a*) Similarity in the nature of the electrical supply; (*b*) uniformity in the gauge of the roadways used in transportation.

Some progress has taken place of late on both of these points; and also important attempts are being made to obtain continuity in transportation. For instance, a commencement was made some time back by the Liverpool Corporation, and by the South Lancashire tramways, to convey both passengers and goods over their joint systems; wherein they had the co-operation of the Mersey Docks and Harbour Board, and of the Great Central Railway.

One of the most serious drawbacks, however, to a satisfactory solution of the many difficulties which prevent the question of the supply of electrical energy being dealt with in a broad and comprehensive spirit, such as is suggested above, is the attitude in which the entire matter has been approached by the Legislature during the past few years—that of treating it as if it was simply a private trading question, and entirely overlooking the numerous and varied interests of the public community.

To illustrate the difference between the private trading concern, and that of the public character of the position which is looming in the near future—if indeed it is not already within a very measurable distance—we may take as an example the belt of country comprised within South Lancashire and the West Riding of Yorkshire, a district extending from sea to sea, teeming with an industrial population and embracing some of the most important trades and commercial enterprises in the British Isles. The district probably contains within it about one quarter of the population, as also of the commercial energy of the whole of England. Over this large tract of land, embracing about 4,000 square miles, the Legislature has granted rights to two private companies for the production and supply of electrical energy, and these rights covering about 4,000 square miles, are practically exclusive ones amounting almost to monopolies, granted in 1900 by the Lancashire Electrical Power Act, and in 1901 by the Yorkshire Electrical Power Act, a number of private traders, yet with the result, in 1906, that so far, practically, little or nothing has been done to carry out those powers.

Nor can it be said that this result is due to any enormous amount of capital required, or to the magnitude of the works which are necessitated.

The result would rather appear to be due to the multiplicity and importance of the large and varied interests throughout this vast district, which are now forcing themselves prominently forward; showing that these interests are too important to be dealt with satisfactorily for the public weal by private traders, no matter how distinguished the individuals may be.

It would seem, therefore, as if the community of interests, so large and important in themselves—of both a public and a private character—as to be almost national in their scope, could only be dealt with by a public

Board, which would represent most, if not all, of the numerous and varied interests, which centre in the large and important portion of England, as that now being referred to in Lancashire and in Yorkshire. And this likewise would apply to other similarly-situated areas allotted to electric power schemes.

Fortunately, examples exist of such public Boards as, for instance, the Mersey Docks and Harbour Board, the pioneer, with its half-century of experience; and others of a similar character. There are Boards connected with the Clyde and the Tyne; there are also the Thames Conservancy Board, the Metropolis Water Board, as well as others, representing inland rivers, and also water authorities.

Nor need the fact stand in the way that Parliamentary powers already exist and protect certain private and vested interests. For did not the same difficulty arise, only with perhaps greater force, against the formation of the Mersey Docks and Harbour Board; in the vested interests of the Liverpool Corporation, in their long-established docks, as also of the more recently appointed trustees of the Birkenhead Docks. Yet these difficulties, and others subsequent to them, have all been successfully overcome, and in a spirit of fairness to all interests, wherever it has been shown that the public weal demanded it.

The advantage of a Board of such a representative character, containing both manufacturers and users of the electric energy, as well as others commercially interested in the welfare and extended development of that supply, would be that it would engender and foster a friendly spirit for its success throughout the entire district, and would thus become essentially a "home-supply;" replacing, thereby, the spirit of continuous and ever-increasing rivalry with which a private company trading for its own advantage and not for that of the district itself, would meet with on all sides.

A further advantage which would follow from this Board, combining general and local interests, working for the benefit of the district itself, would be the exclusion of outside, and, still more, of foreign interests, which last, already have done much in this country, it is said, to hamper, and even to mar, the progress of electric power schemes.

All recent Parliamentary legislation connected with Electric Powers Acts has been based upon the Report (in 1898) of the Joint Select Committee of the House of Lords and the House of Commons, known as Lord Cross's Committee, he having been chairman thereof. This committee was specially appointed for the purpose of considering the subject of "Electrical Energy (Generating Stations and Supply)." In their report, the Committee recommend, practically, that the lines upon which with certain modifications the Electric Lighting and Power Acts, which had been passed between 1863 and 1898, should be continued. These were, to grant compulsory powers, either to local authorities, or to incorporated companies, for the carrying out of the electrical supply under conditions settled by the Board of Trade; and these powers practically, though without it, was not so stated, gave the undertakers a monopoly of the electric supply in the district allotted to them.

Subsequent experience has shown, however, that the conditions under which the earlier Electric Lighting and Power Acts, each with its moderate area of a few square miles, and having but one common centre for the various interests, both public and private, are altogether different from those which occur in the electric power schemes, such as contemplated by this Committee, with their areas of 1,000 square miles, and in a few cases up to 2,000 square miles. For, in the latter case, the large area invariably contains within it a number of the local centres of the earlier Acts, often conflicting one with another, and therefore very difficult to weld into one homogeneous whole, and under one single managing body. But when, besides this diversity of "public" interests in various parts of the district, there are added the numerous and often very conflicting claims of the manufacturing, the trade-carrying, and other so-called "private" interests, the difficulties are still further increased; and, the more so, because all these "private" interests are inclined to resist being placed in the hands of a virtual "monopoly" by a particular class. These difficulties, it is safe to say, did not present themselves to the Select Committee of 1898; nor were these difficulties considered in their "Report." Nevertheless, those difficulties are arising every day, and to ensure success for the electric power supply, they must be met as far as possible.

Then again, as to the Stock Exchange, and the absence of financial success which has followed some of the appeals made by the promoters of electric power schemes. With a concern beset with conflicting difficulties such as have just been stated, and in itself, in some cases, almost "a tied concern," and also

largely without the confidence of the class whom it would desire to secure as its customers, is it surprising that the financial appeal should not be a success? But what is the requisite, it may be asked, that is necessary to secure this confidence in the electric power supply? "Community of interests with the promoters in the welfare of the concern, and a proportionate share with them in the management of the electric supply, and for the benefit of all interests in any way connected with it." This is the reply of some who have followed these matters closely; whose opinion from their acquaintance with the different bearings of the question, is entitled to consideration.

It is true that an attempt by some of the electric power companies has been made to offer to share with their customers the profits above a certain figure. But this does not suffice to arrive at anything like complete success. To do this, there needs a proportionate representation on the managing body of all interests concerned in the development of the electric supply. But this means a public body specially selected in its members and adapted to the varying conditions of the locality under consideration, and the larger the area of the district the greater the difficulty in reconciling and in duly representing the various interests contained within it. But the task of doing so successfully, within the limits of a public Board, is not impossible, since many examples thereof exist in various parts of this country. Probably one of the best-known examples of a public Board having within it a number of interests to be dealt with, and successful in dealing with them, is that of the Mersey Docks and Harbour Board at Liverpool, which has an existence of half a century. The Board was formed in 1857, and it took over the control and management of the docks at Liverpool, and at Birkenhead. It consists of twenty-eight members, of whom twenty-four are elected by the dock ratepayers, and four are appointed by the Conservancy Commissioners of the river Mersey, viz., the First Lord of the Admiralty, the President of the Board of Trade, and the Chancellor of the Duchy of Lancaster.

A person to be qualified to be an elective member of the Board must reside within the Customs' port of Liverpool, or within ten miles of the outward boundary of that port. The members are elected for four years, and eligible for re-election. They receive no remuneration for their services.

The qualification of an elector is the payment to the Board of rates, due from him in respect of ships or goods, to an amount of not less than £10, in the year preceding the 1st of August. He must be a British subject, or, if a foreigner, be resident in the United Kingdom, and his name must be on the list of dock electors; this in 1905 contained 3,500 names.

The above are the official regulations relating to the constitution of the Board set out by Act of Parliament. In order, however, to ensure the fair and proportionate representation of the various interests on the Board, such as of steamers and sailing vessels, of corn, cotton, general produce, &c., an arrangement, or understanding, has come into operation, under which, by tacit consent, among the 24 elected members, persons are elected representatives of certain trades carried on in the ports. This arrangement has, however, no binding effect, and occasionally persons are nominated for election independently of this arrangement. To this tacit understanding, however, is attributed much of the fairness, and the smooth working of the Mersey Docks and Harbour Board. The various interests, based upon the amount of dock dues, &c., paid by each trade, are generally supposed to be divided among the 24 elective members of the Board in the following proportions: steamers and sailing vessels, 12 members; general produce, 4; corn, 2; cotton, 2; provisions, 1; fruit, 1; and independent, 2. The total income of the Board in 1905 amounted to somewhat over 1,250,000 sterling, of which the steamers and sailing vessels contributed £700,000.

The Clyde Conservancy, 1871, consists of twenty trustees:—Eleven being elective (six by the ratepayers of Glasgow, three by those of Greenock, and two by those of Port Glasgow). Five appointed ones—two by the Chamber of Commerce of Glasgow, two by the Chamber of Commerce of Greenock, and one by the Merchants' House of Glasgow. Three are *ex officio*, viz., the Chairman of Trustees of the Clyde Navigation, of the Port and Harbour of Greenock, and of that of Port Glasgow, respectively; and Sir Michael Shaw Stewart, Bart., and his heirs male, in the estate of Greenock. They are termed the Trustees of the Clyde Lighthouses. The qualification for an elector of, as well as for an "elective trustee," is, that during the year previous to the 31st August, he shall have paid £2, or upwards, of rates, under this Act; and also be resident within three miles of the city of Glasgow, the town of Greenock, or the town of Port Glasgow.

The Tyne Improvement Commission, dating back to 1850, is another example. It really means the "Port of Newcastle," extending from the sea to a point called "Hedwin Streams," a certain distance above Newcastle. The Tyne Improvement Commissioners are eighteen in number, four being nominated in the Act, six by the Council of Newcastle, two by that of Gateshead, three by that of Tynemouth, and three by that of South Shields. The voter for the Commissioners to be, either (1) a shipower of a vessel of at least 100 tons, and which has paid tonnage dues dues during the preceding year; entitling him to one vote for the first 100 tons, and to one vote for each additional 250 tons, up to a maximum of eighteen votes; or (2) a coalowner, shipping coal during the past year, is entitled to one vote for the first 10,000 tons, and to one vote for each additional 25,000 tons up to a maximum of eighteen votes; or (3) a trader, paying dues, toll, &c. (other than on coal and coke) during the preceding year, is entitled to one vote for the first £10 paid, and to one additional vote for each £25 paid, up to a maximum of eighteen votes.

The Thames Conservancy Board, as reconstituted by the Act of 1894, consists of thirty-eight conservators; of whom the Admiralty nominates two, the Board of Trade two, the Trinity House two, the London County Council six, the Corporation of London six, the County Councils of Berks, Bucks, Essex, Herts, Kent, Gloucester and Wilts (together), Middlesex, Oxford and Surrey one each; also the Councils of Oxford, Reading, West Ham and the Metropolitan Water Board one each; likewise the Shipowners' elect three, the owners of sailing barges and steam tugs two, the dockowners one, and the wharfingers one.

The Metropolis Water Board, 1902, consists of a chairman, a vice-chairman, and of the following nominated members—fourteen by the London County Council, two by the Corporation of London, two by the City of Westminster, one by each of the Metropolitan Borough Councils, one by each of the County Councils of Essex, Herts, Kent, Middlesex and Surrey, one each by the Thames Conservancy, and by the Lee Conservancy, one each by the Urban councils of West Ham, East Ham, Leyton, and Walthamstow, and one each from eight groups of urban and rural district councils situate Essex, Kent, Middlesex, and Surrey respectively.

The Derwent Valley Water Board (1899) is an interesting example, as its constitution was the result of a long discussion in Parliament. Originally four distinct Bills were deposited by the Corporations of Derby, Leicester, Nottingham, and Sheffield, each to obtain independent water rights over this Derbyshire river. But by the insistence of the House of Commons Committee, under the chairmanship of Sir John Brunner, Bart., the claims of all of these Corporations were combined under one Board, of thirteen members, constituted in the following proportions:—Derby Council three, Leicester four, Nottingham two, Sheffield three, and the Derby County Council one member.

In the above quoted examples, there may be found a large number of interests, differing widely in their character. It is interesting, therefore, to note the various ways in which they have been treated, so as to ensure a commercial amount of satisfaction. It is to be hoped, that these and other examples, which may, perhaps, be instanced in the discussion on the subject of the paper, may prove of value as suggesting a mode of reconciling the various, and often conflicting interests which are found to occur, and which have to be dealt with in connection with the electric supply of these Power Acts. The main object, of course, is to endeavour to secure a mutual confidence between the "suppliers" and all classes of the "supplied." So that all may feel, that each interest is being treated w ih consideration, and in such a spirit of fairness, that their united co-operation is enlisted in the development of the electric supply, so as to aid, and ensure to it the largest amount of success. And also that, while doing this they may, each and all, endeavour to render the terms of the supply such, as may be of National assistance, in the competition with foreign countries.

DISCUSSION.

The CHAIRMAN remarked that the subject of the paper was extremely important, and it was a great pity that Mr. Shoolbred was unable to be present to advocate his views. The author was one of the pioneers of the electrical industry, which was possibly going to be one of the most important from the point of view of the national prosperity that had arisen since the date of the introduction and rapid development of the railway system of the kingdom. That was a very broad statement to make, but he had been connected with the industry for some years and as the time rolled on the more sure he became that his surmise was approximately correct. Whether the views expressed by Mr. Shoolbred as to the causes of the present want

of phenomenal success of electricai power companies were correct he was not prepared to say. That the success had not, from the financial point of view, been as great as was anticipated was true. The one great thing which troubled the pioneers in the early days was that they were all afraid as to whether they would get the custom which they required as the result of their efforts. That difficulty had solved itself, because the custom was there. People were anxious to have the supply, but the difficulty was to give that supply. That he considered arose from the heavy financial troubles under which England had laboured during the last five or six years, financial troubles which were not yet at an end. All the spirit of speculation seemed to have gone from the London Stock Exchange, and from those who in the past were in the habit of finding money for the promotion of the new industries of the country. He was speaking as one having an intimate knowledge when he said that at present the money invested in power companies in England did not amount to a very large sum compared with what it would be in ten years' time. Fully three-fourths of it came from the Continent or from America. That could be traced back to the early troubles connected with electricity in this country, troubles due to the Act of 1881, just when there was a great boom in electrical undertakings. The Legislature interfered; grandmotherly solicitude for the dangers to the people was paramount, and electrical speculation was checked for ten years, if not more. In the meantime the Continent and America went ahead, the result being that those countries had earned a large surplus, which they had brought over and used in England. The Englishman did not at present appear to appreciate the possibilities of legitimate industrial enterprises in the supply of a want which certainly existed. He would do so sooner or later, but at present there were financial difficulties which the author of the paper had foreshadowed. Whether the modes Mr. Shoolbred had suggested were the best, or whether it was not better to leave the matter as it at present stood, namely in the hands of private enterprise, he was not prepared to say.

Mx. Arthur J. Martin, M.Inst.C.E., said the first point in the paper which struck him was the backwardness of electrical enterprise in this country, ascribed to the attitude of the Legislature in treating the question as one of private trading. Whilst the paper was being read, he made the same mental observation as the Chairman, that the real and deeper cause of the backwardness was the attitude of the Legislature in taking an over solicitous view of the public interest and public safety, and in thus throttling this new industry by their grandmotherly enactments. Probably nothing would do more to revive confidence in electrical undertakings, and to stimulate investments therein, than the removal of some of the restrictions, so as to enable the undertakers to have some prospect of working at a profit. He thoroughly agreed with the author as to the clashing with conflicting interests which, as was said, must be avoided as far as possible. It was desirable, also, to unify the interests of the suppliers and the supplied. Whether Mr. Shoolbred's was the best method of bringing that about was a question upon which most of them would hesitate to pronounce an opinion without further particulars for consideration. A Joint Board such as was proposed had very great advantages in dealing with certain classes of questions, especially those of a semi-judicial nature such as were dealt with by the Rivers Boards, the Thames Conservancy, and other Boards. Whether a body of that kind would have the necessary enterprise and initiative in a trading operation such as was contemplated was another matter. If they could not go so far as the author in the means proposed for bringing about harmony of interests, they would, at any rate, agree with him that a clashing of interests was by all means to be avoided. With regard to railways, whilst they offered a magnificent example of what private enterprise, under proper conditions, was capable of doing, still they presented certain warnings. Anyone who had occasion to travel from one side of the country to another, over the lines of several railway companies, and desired to make his trains fit in, realised that the competing interests of those companies did not promote the best interests of the public. The author had not gone very far into the technical side of the paper, but it was not a question merely of electrical supply. We should go to the root of the problem of utilising the store of potential energy in this country to the best advantage; so that such wastes of power and energy as occurred in connection with blast furnaces, and in the present type of coke ovens might be avoided in future; in other words, that the generation of electricity might be taken in hand concurrently with the operations he had referred to. Parliament could, of course, do a great deal, either by legislation, or by refraining from legislation, for a danger which must be kept in view was that which arose from the piecemeal treatment of such questions. For instance, one group of companies brought up a number of Bills and Parliament dealt with them in the light in which they were brought forward by the promoters, who possessed certain active interests, to the detriment of those who were opposing. In considering the clash of interests which took place in the committee-rooms of the House, the Legislature was apt to lose sight of the broader interests of the nation and the consumer. At a meeting of the Smoke Abatement Conference, held in Westminster last December, the following resolution, which he thought had a bearing on the question, was passed:—"That in view of the need for husbanding our coal resources, the deplorable and unnecessary evils produced by smoke and fogs, and the desirability of providing a cheap smokeless fuel for domestic and

industrial use, the Councils of the Royal Sanitary Institute, and the Coal Smoke Abatement Society, be asked to join in a memorial to His Majesty's Government, setting forth the urgency of this question." The supply of electrical energy was not specially referred to, but in drafting that resolution he had regard to the supply of energy of all kinds. He trusted that means would be taken for impressing upon the attention of His Majesty's Government the views which Mr. Shoolbred had set forth, and the desirability of taking steps to consider the supply of energy in all forms to the country, and the removal of any restrictions which hampered that supply.

Colonel Allan Cunningham said that anyone who had travelled abroad could not help being struck with the fact, to which the author had particularly drawn attention, of the backwardness of England in all matters connected with electric light and electric power supply. One reason for that state of affairs could be discovered by looking at the matter from the historical point of view. Electric lighting on a large scale preceded the introduction of the use of electric power by a considerable space of time, and when the question of electric lighting came prominently before the public in this country, England was already supplied with a very good gas supply. The introduction of illuminating gas was an English invention. A very large sum of money was invested in gas undertakings in this country, and that financial consideration had stood in the way of England obtaining a good electric lighting supply at an early period. In a comparatively poor country such as Norway electric light was commonly in use long before England was even fairly supplied with electricity, the reason being that Norway was not supplied with gas when electric lighting came into vogue, and also because electricity could be cheaply produced by using the waterfalls of the country. He, therefore, thought the backwardness of England in providing itself with electric power could be largely traced to its being previously well supplied with gas.

Mr. Leon Gaster said the question of the necessity of generating electrical power cheaply had been raised on many occasions, but the problem to be solved was how it was best to be accomplished. A great amount of steam plant and cheap coal existed in this country, and under those conditions the centralisation of power had not that stronghold which it had on the continent, where coal was very expensive and centralisation acted favourably in the cheap production of electricity. It was a moot question whether blast furnace gas and other gas should be used in the cheap generation of current. Many years ago he suggested the desirability of using waste gases, but the use of very large gas engines, run with blast furnace gas, had not as yet shown the great superiority over steam plants which was anticipated. It was only necessary to call attention to the large electrical installation on the Tyne to prove that electricity could be produced cheaply in large central stations. The figures were available for the last five years' working of that station (according to Mr. E. Garcke's article published in *The Times* Engineering Supplement of May 16th). Five years ago only 900,000 units were sold, compared with 30,000,000 in 1905, while the cost of production in the first year was twopence per unit against a little over one-halfpenny at present. Five years ago the consumers paid fourpence per unit, whereas they were now charged about one penny. That was conclusive proof that a large central station near to its source of power, coal, would contribute largely to an extensive use of electricity. Another point which had kept back the use of electrical power was the fact that the promoters of electrical companies had laid too much stress on the merits of their own system in comparing it with gas. If the electrical companies fairly faced the work done by the gas companies he thought they would be doing greater good than by making indiscriminate statements with regard to the advantages of electricity while they entirely overlooked the benefits of gas. Electric power had proved itself to be eminently satisfactory where vested interests had not stood in the way and plenty of capital had been available. One point to which he specially desired to direct attention was that any firms of manufacturers, in opening new works, should make a point of writing off sufficient capital for scrapping antiquated machinery and thereby put themselves in the position of being able to move along with the times. The more people became acquainted with the merits of electricity, and judiciously used it, the more the necessity of distributing it in bulk for power purposes would be recognised.

The Chairman, in reply to the various remarks which had been made, said all electrical engineers recognised, as Colonel Cunningham had suggested, that the rapidity of the development of electric lighting on the Continent and in America was largely due to the fact that those countries did not at the time possess gas installations, whereas there were large gas undertakings in this country. It was suggested by people who professed to know, and who did not hesitate to make accusations against others, that the legislation of 1881 was promoted by the gas interests against the electric lighting, and that possibly might be true. With regard to Mr. Martin's suggestion that it was no use to deal with the subject piecemeal in various Bills, having for the past few years been engaged on seven or eight different power Bills, he was able to say that one thing which the authorities of both Houses of Parliament preached to promoters of such Bills was that they should be made uniform, and therefore the authorities were awake to that particular point. It had been suggested that blast furnace gas and gas engines should be used, but a

gas engine of 300 or 400 horse-power was a very unsatisfactory machine. He heard an engineer describe it 15 years ago as an "ungodly" machine, and he thought it bore that character at the present time. For the information of the laymen present, it might be of interest to state that it was now contemplated in central stations to instal machines, not of 400 horse-power, but of 1,000, 8,000, or 10,000 horse-power, as being more economical and more able to earn dividends, and satisfy the demand; but it would be fully understood that some considerable time must elapse before gas engines of that size could be made. Altogether apart from such considerations, blast furnace gas and coke oven gas were only to be obtained where blast furnaces and coke ovens existed, and those places were few in number, and were not, as a rule, situated in the particular district where it was desired to put down a central station. The tendency of a power company now-a-days was not to build three or four stations, as originally contemplated, but one station spreading, with its mains, twenty-five miles around the station, and covering therefore an area of a thousand square miles, which was about the average area of a power company in England. That was found to be economical practice, especially with large units of power. Unless the blast furnaces were brought to the generating station, they were very unlikely to be found in the particular position where a station ought to be geographically situated from the electrical point of view, and that was a circumstance which must tell against the use of blast furnace or coke oven gas. It must further be remembered that, with the new turbines, an extremely efficient machine could be obtained at a low capital cost, physically adapted to the production of electricity, *i.e*, there were scarcely any reciprocating parts, the mechanism revolving, as did also the armature of the generator. When it was remembered that a gas engine, using blast-furnace gas, only saved upon the item of coal, and that a turbine could be used which produced a current with a very low consumption of coal, there were very many reasons why promoters hesitated before putting down big engines to work with blast-furnace gas. Electricity could be produced by the big machines he had mentioned at a works' cost of 3·8ths of a penny, the coal cost of which was less than 1·8th of a penny; and it was only possible to save theoretically by the use of blast furnace gas and big gas engines possibly 10 per cent. of that amount, or practically $1\frac{1}{2}$ per cent. of the total cost. One great advantage connected with electricity was that it was possible to tell from moment to moment practically what it was costing to produce the current and the amount of current being sent out, and therefore what the profits were. In no other business was that true. He was a director of a great many companies, where returns were made once a month, after the profit or loss had been made, and there was no possibility of control; but in an electrical undertaking it was possible to know from moment to moment what was happening, and if any difficulty arose, and it was not immediately reduced to its lowest possible limits, there was trouble when the next meeting of the Board of Directors took place.

Mr. LEON GASTER thought it would be of interest if the Chairman would inform the meeting whether, in his experience, there was any economy in the production of electrical energy in large stations to run machines in units of over 5,000 horse-power.

The CHAIRMAN, in reply, said that in the development of electrical power schemes a smaller unit than 5,000 horse-power or 5,000 kilowatts, was desirable; but when a company was in the position of supplying 60,000,000 or 70,000,000 units per annum, and their demand never fell below that amount, it was economical to use a 5,000 kilowatt set. The difficulty was that until that position was attained a big implement was being used to do a small amount of work. Experience pointed to the fact that, in starting an electrical power undertaking, a smaller unit should be used, which could be gradually developed into a larger one as the demand grew. The result was that sets of 10,000 horse-power were being put up abroad to a considerable extent. He had heard during the past week, on absolutely reliable authority, that in Westphalia, where power supply had been used for some considerable time, a new station was to be put up containing ten units, each of 10,000 kilowatts. No station of that size had yet been contemplated in England, and was not likely to be for some considerable time. But Germany was so far ahead of England in that respect that machines were absolutely in course of construction for supplying the power he had mentioned. As a further illustration, he would mention that four years ago he was in Vienna which, at the time, had two fairly large power stations. At the time, a station was being put up containing 37,500 horse-power, in ten units of 3,750 each, and the buildings were made sufficiently large to accommodate double that capacity, *i.e.*, a station for 75,000 horse-power; and not a half-penny of custom had been secured at the time he was there. That was the way in which the Continent looked at the question of the supply of electrical energy, an entirely different point of view to that taken up in this country. One of the largest stations in England contained only 7,500 horse-power. In conclusion, he desired to propose a hearty vote of thanks to Mr. Shoolbred for his paper, and also to express to him, on behalf of the meeting, their condolences with him in the sad bereavement he had sustained.

The resolution was carried unanimously, and the meeting terminated.

Mr. SHOOLBRED writes, in reply, that he is glad to find, that the Chairman, and the other speakers,

were all of opinion, that here in England the facilities for obtaining a general supply of electricity were less than in other countries. Also, that although that backwardness might be due to several causes, yet among them there existed a certain amount of over-legislation, as also of mis-directed legislation which had hampered the progress of the development of the supply of electric power. The various examples, which he brought forward in the paper, of a variety of interests, of a conflicting character in some cases, were instanced to show how difficulties of a commercial character were being dealt with satisfactorily by a public Board, which represented to a large proportion, at least, the various interests. And, admittedly so in a manner much more satisfactorily to all concerned than if the management had been confined to certain private traders. He had only put forward the particular cases quoted in the paper as an example of the efficiency of a public Board in the solution of some of the difficulties and drawbacks which had been found to arise in the case of the development of these electric power companies. He therefore had suggested the utilisation of a public Board in these cases. But as to the character and composition of that Board, it must, of course, vary considerably with the circumstances under which the electric supply was conducted, and the varying nature of the interests concerned. There was one point particularly which must not be lost sight of with these huge supplies of electricity, especially where one of these large districts was affected by the policy and working of its immediate neighbours. In these cases the method and working treatment of the various interests of the community was of vital importance, thus constituting a necessity for moulding these various arrangements into one common and uniform policy, which might be termed almost national in its character—at least in our dealings with other countries. In conclusion, Mr. Shoolbred begged to thank the Chairman and the other speakers for their kind sympathy, and the terms in which they had referred to his recent bereavement.

STATISTICAL ABSTRACT OF THE BRITISH EMPIRE.

In the *Journal* of April 14, 1905, attention was directed to the first number of the "Statistical Abstract of the British Empire," intended to meet "the growing demand for statistical information as to the trade, shipping, and production of the Empire, and especially as to the trade relations both between the Empire and foreign countries, and among its constituent parts." The second number has now been issued, and contains much additional matter, including a summary of the total foreign and inter-Imperial trade of the British Empire, the value of coal, diamonds, and gold produced, the quantity of maize and rubber, &c.

The growth or decrease in our trade with the principal countries of the world, taking the figures for the six years 1899-1904, are shown in the following Table, which gives our imports from and exports to the countries named :—

Country.	Year.	Imports.	Exports.
		£	£
Russia......	1899	20,524,000	19,748,000
,, ...	1903	33,971,000	17,267,000
Denmark....	1899	12,448,000	4,466,000
,, ...	1903	16,134,000	4,267,000
Germany....	1899	40,165,000	53,697,090
,, ...	1903	46,075,000	63,304,000
Belgium	1899	27,027,000	20,275,000
,, ...	1903	32,648,000	22,080,000
France......	1899	58,343,000	35,696,000
,, ...	1903	55,621,000	41,088,000
United States	1899	165,224,000	62,594,000
,, ...	1904	174,817,000	72,063,000
Japan	1899	4,514,000	13,396,000
,, ...	1904	4,913,000	12,568,000

It will be seen that our imports from France still show substantial decrease, although there was an improvement of over a million and a-half in 1904 as compared with 1903. Our exports to Russia, Denmark, and Japan, were less in 1904 than in 1899; but in the case of Japan there was an improvement of over £800,000 as compared with 1903.

The rate of increase in the imports of India and the Colonies with foreign countries was not maintained in 1904, when they amounted to £107,158,000 as against £109,785,000 in 1903. The Australian imports fell from £12,975,000 in 1903, to £10,034,000. In the same period the Natal imports fell from £4,517,000 to £2,646,000; those of the Transvaal, from £1,429,000 to £1,255,000; of the Cape Colony, from £9,827,000 to £5,080,000. On the other hand India's imports increased from £20,203,000 to £25,140,000; those of the Dominion, from £36,138,000 to £38,138,000; of the Straits Settlements, from £12,572,000 to £13,075,000; and of the West India islands, from £3,088,000 to £3,157,000. Turning to the exports from the Colonies and India to foreign countries, it will be found that the exports from India, comparing 1903 with 1904, increased from £58,499,000 to £60,983,000; the exports from the Commonwealth, from £12,717,000 to £14,679,000; from the Domion of Canada from £17,241,000 to £17,384,000; and from West Africa, from £1,987,000 to £2,267,000. On the other hand the exports from the Cape of Good Hope have fallen from £3,078,000 to £1,664,000; and from the West Indies, from £3,453,000 to £3,132,000. In the aggregate the exports from India and the Colonies to foreign countries, have increased from £119,954,000 in 1903, to £122,940,000 in 1904, an improvement of £2,986,000.

Passing to the trade between the United Kingdom

and other part of the British Empire it will be found that—still taking for comparison the two years 1903-4—our imports from India increased from £36,427,436 to £44,144,533, and our exports from £45,157,015 to £55,110,683; our imports from the Commonwealth from £22,628,053 to £27,950,632; and our exports from £18,161,169 to £19,871,247; from the Dominion of Canada imports increased from £22,628,053 to £27,950,632, but exports decreased from £12,853,338 to £12,289,648; from Hong Kong imports fell from £687,329 to £541,811, but exports rose from £3,138,511 to £5,061,724; our imports from the West Indies from £1,878,685 to £2,172,497, exports declining from £2,388,338 to £2,337,005. Our imports from the Cape Colony, exclusive of bullion and specie, fell from £5,201,786 to £4,933,489, and our exports to that colony, from £18,897,515 to £13,087,689. Taking the aggregate trade of the United Kingdom for the two years under review, with India and the Colonies, the total of imports increased from £140.267,400 to £150,995,459, of which £7,717,097 is to the credit of India; whilst our exports increased from £131,044,415 to £135,669,334; the increase in the exports to India being no less than £9,953,668. If the increase in the exports to India is deducted, it will be seen that the home trade with the Colonies was several millions less in 1904 than in 1903.

If the trade between the United Kingdom and other parts of the Empire is analysed, it is found that—taking the same two years—our imports of butter increased in value from £2,697,536 to £4,853,764; of wheat, wheat meal, and flour, from £10,658,472 to £16,061,004; of raw sugar from £622,315 to £1,031,288; of caoutchouc and gutta percha (raw) from £936,544 to £1,127,381; of tin in blocks, ingots, bars and slabs, from £4,198,234 to £4,676,712. Contrariwise, imports of living animals fell from £3 483,253 to £2,701,173; of meat of all sorts, from £8,026,814 to £7,461,235; of fruit of all kinds, from £1,656,707 to £1,583,577; of wood and timber, from £6,299,033 to £5,309,218; of oil (including petroleum and paraffine, from £2,321,304 to £1,995,629: of hides and skins, from £3,557,256 to £2,979,446; of wool, from £18,297,546 to £18,046,284; of leather (undressed), from £2,639,401 to £2,551,643; of copper ore, Regulus and Unwrought, from £1,483,147 to £1,372,084. In exports, the chief movements was the increase in cotton piece goods, from a value of £25,728,711 to £30,252,229; of worsted tissues, from £4,872,938 to £5,798,731; and of coal, from £1,816,286 to £2,296,897. On the other hand, the value of haberdashery exported fell from £1,706,354 to £1,261,796; of apparel and slops, from £5,637,947 to £4,053,784; of leather wrought (includiug boots and shoes), from £2,248,300 to £1,955,659; of iron and steel rails, from £2,166,221 to £1,444,731; of "other kinds of iron," from £7,166,736 to £6,051,345, and "other kinds of steel," from £1,874,835 to £1,486,274; of railway rolling stock, from £1,313,095 to £1,018,748.

Turning to production, and commencing with gold, the United Kingdom produced 5,495 ozs. of gold in 1903 and 19,655 ozs. in 1904. Australia shows a slight decline from 4,566,654 to 4,499,647 ozs., Western Australia receding from 2,436,311 ozs. to 2,373,021 ozs., and Queensland from 921,363 ozs. to 877,238 ozs. New Zealand, too, shows a slight decrease from 533,314 ozs. to 520,323. The Canadian output fell from 911,639 ozs. to 800,000, but the Transvaal improved from 2,972,897 ozs. to 3,773,517 ozs., and Southern Rhodesia from 231,827 ozs. to 267,737 ozs. It is noticeable that the gold exports from British Guiana fell from 104,525 ozs. to 90,336 ozs. The figures relating to wheat production are again very striking. The production of British India, which in 1903 was 359,936,080 bushels, fell in 1904 to 281,263,397 bushels; and the production of the Commonwealth from 74,149,639 bushels in 1903, to 54,527,491 bushels in 1904. New Zealand increased her production from 7,891,651 bushels to 9,123 673 bushels, and the Dominion, from 69,029,266 bushels to 78,578,162 bushels. The production of the United Kingdom continued to fall, and reached only 37,919,781 bushels. The quantity of coal produced in the United Kingdom increased from 230,334,469 tons to 232,428,272 tons, but both the output of the Dominion and the Commonwealth showed decreases. In India, however, the output increased from 7,438,386 tons to 8,216,436 tons. The iron ore produced in the United Kingdom showed a slight increase, from 13,715,645 tons to 13,774,282 tons, and that of pig iron was slightly larger, increasing from 4,500,927 tons to 4 524,412 tons. There was a considerable increase in the value of diamonds found, from £5,472,690 to £6,422.488, the increase being almost entirely from the Orange River Colony and Transvaal production. Australia produced less wine in 1904 than in 1903, 5,633,899 gallons as against 6,395,894 gallons in 1903, but the produce of the Cape increased from 5,332,349 gallons to 5,686,672 gallons. British India continues to increase her production of tea. In 1903, it was 209,041,888 lbs.; in 1904, 222,203,661 lbs.; whilst the Ceylon product increased from 151,120,009 lbs. to 158,952,965 lbs. Natal, too, increased her production from 1,761,091 lbs. to 2,406,367 lbs. The total output of coffee in 1904 was only 35,814,774 lbs. as compared with 38,356,801 in 1903, the chief decrease being in the output of Jamaica and Ceylon. The quantity of sugar produced in various parts of the Empire in 1904, was 57,300,000 cwts., as against 49,700,000 cwts. in 1903; India again showing the largest increase, from 37,440,000 cwts. to 43,323,000 cwts.

The production of cotton shows a gatifying increase from 1,268,648,000 lbs. to 1,406,688,000 lbs., the principal increase being in India, from 1,267,245,200 lbs. in 1903 to 1,402,527,200 lbs. in 1904; but many of the West Indian islands have increased their output considerably—for example, St. Vincent from 43,392 lbs. to 126,178 lbs., and Barbados from 550 lbs. to 101,861 lbs., whilst British

Central Africa (291,200 lbs.), Southern Nigeria (285 639 lbs.), and Northern Nigeria (187,233 lbs.) were exporters for the first time.

The present number of the abstract includes for the first time the quantity of rubber produced within the Empire. The product for 1904, 8,596,000 lbs., was higher than for any year since 1899, when it was 11,135,000 lbs. The increase on the Gold Coast, from 2,258,981 lbs. to 4,013,837 lbs. is noteworthy, as is that of Sarawak, from 222,000 lbs. to 414,800 lbs., and of Southern Nigeria from 1,117,803 lbs. to 2,408,926 lbs.

The second part of the Statement deals with shipping. In 1903, the tonnage of sailing and steam vessels on the register was 11,831,439 tons, and in 1904 it increased to 12,156,101 tons. The decrease in the tonnage of sailing vessels continued, from 2,802,053 tons in 1903 to 2,729,608 tons in 1904, but steam tonnage increased from 9,029 386 tons to 9,416,493 tons. In most of the colonies there was some increase, but the Dominion again showed shrinkage, from 681,646 tons to 680,780 tons, this decrease being entirely in sailing ships, the steam tonnage having increased from 205,123 tons to 213,915 tons. If the shipping entered at principal ports in the British Empire is taken, it will be found that London remains far ahead of any other port, although slightly less than in 1903, being 10,788,212 tons, against 10,958,739 tons in 1903. The next port in importance is Liverpool, with 7,986,584 tons, and then the Tyne ports, with 4,805,067, they having for the first time won that place as against Cardiff, which, though showing increase as compared with 1903 only totalled 4,795,406 tons. Glasgow attracted only 1,566,478 tons. Of Colonial ports Hong Kong ranks first with no less than 10,734,063 tons, almost equal to that of London, and Singapore next with 5,908,858 tons, Colombo coming close with 5,195,822 tons. In shipping cleared Hong Kong maintained her premier position with 10,712,962 tons, Cardiff coming second with 8,324,066 tons, and London third with 7,850,947 tons; Liverpool remaining fourth with 6,730.206 tons, and the Tyne ports fifth with 6,589,972 tons.

A new feature of the Statement is the total amount retained for consumption of various articles, and the amount retained for consumption per head of population in the principal parts of the British Empire. Mention may be made of the consumption of one or two articles per head. The consumption of tea in the United Kingdom was 6·00 lbs., there having been a fractional fall each year since 1901, when it reached its highest point, 6·16. The people of New Zealand drink more tea than those of any other portion of the Empire, 6·96 lbs. per head. The consumption of beer in the United Kingdom in 1904 fell to 28·8; at the Cape it was only 1·0. The consumption of wheat in the United Kingdom was 5·99 bushels per head, rising in the Commonwealth to 9·16 bushels, and falling in British India to 0·67.

AN AMERICAN PRIMER OF FORESTRY.*

This little book of 88 pages, about half of which consists of beautiful plates illustrating the subject, is the third edition of a work published in 1899, the first edition comprising 10,000 copies, and the second edition (published in 1900), 35,000 copies. Ten thousand copies were again published in May, 1903, forming the third edition, and showing the great demand for such a work in the United States of America. In that vast republic, the demands for timber, wood-fuel, and wood-pulp, are now so great, that Mr. W. Power, M.P. for Quebec West, a member of an influential Canadian lumber company, has recently stated that the United States is to-day bidding for all Canadian wood, and paying higher prices for it than can be obtained in the British Isles.

Such a primer does not pretend to teach forestry, which is a vast subject, requiring years of study, as no one knows better than Mr. Pinchot, the author; it is intended merely to state the principles on which good forestry is founded. When quite a young man, Mr. G. Pinchot, who is now the head of the United States Forestry Department, came to Nancy, in 1882, to study forestry, proceeding thence to Zurich and to Germany. He made, in 1890, an extensive tour in the German forests with Sir Dietrich Brandis and the students of the Cooper's Hill Forest School, and acquired from the great organiser of Indian forestry much of the strategetical knowledge which has enabled him to build up the present Forestry Department in Washington, with corresponding branches in most of the States of the Union.

The plan of the book is to treat the forest as a complex organism, far more than a collection of trees standing in one place. "It has a population of animals and plants peculiar to itself, a soil largely of its own making, and a climate different in many ways from that of the open country. Its influence upon the streams, alone makes farming possible in many regions, and everywhere it tends to prevent floods and drought. It supplies fuel and lumber, the raw material without which, cities, railroads, and all the achievements of material progress, would have been either long delayed or wholly impossible. The forest is beautiful as it is useful. From every point of view it is one of the most helpful friends of man. Perhaps no other natural agent has done so much for the human race, and has been so recklessly used and so little understood."

The wood, roots, branches, and stem of a tree are described in Chapter I., and its food and the methods of obtaining it, as well as all the vital processes involved in its growth. The plates representing the structure of wood are most beautiful, several of them being full-paged.

* "A Primer of Forestry. Part I. The Forest." By Gifford Pinchot. Bulletin 24, Direction of Forestry, U.S. Dep. of Agriculture. 1903.

Chapter II. deals with the trees in a forest, their various demands for heat, moisture and light, the terms *tolerant* and *intolerant* being used, instead of *shade-bearing* and *light-demanding*, as with us. As tolerance might have reference to heat or cold, as well as to shade, no great advantage appears to result from this nomenclature, as opposed to that practised for at least a century in Europe. The reproductive power of trees from the stool and by seed is then dealt with, and among others an excellent plate appended shewing red cedars, the seedlings of which form an avenue along a high road; all these trees have sprung up naturally from seed, which has insinuated itself in the fence bounding the farms on either side of the road, the fence affording the necessary protection against man and animals. The succession of crops of trees follows, with pure and mixed forest, illustrations being given of both, and the question discussed is of *gregarious* and *scattered* species, or as we should term them, *social* and *sporadic*, or *ruling* and *dependent* species.

Chapter III. deals with the life of a forest, considered as a community of trees, the protection afforded to individuals by a dense growth of the whole wood being well described, and the great advantage to the soil and welfare of the wood by close leaf-canopy. The author describes seven ages of forest trees: seedlings, small and large sapling, small and large poles, trees, and veterans, the latter being over two feet in diameter. The process of growth of masses of seedlings into veterans, through all the stages is well dealt with, as are the early formation of cover, the struggle for existence between the individuals that form the wood, and the treatment necessary to secure a good height growth with sufficient growth in diameter, which is one of the tests of good forestry. The chapter then proceeds to explain the end of the natural forest by old age and decay, and the importance of harvesting the crop before the veterans are superannuated. It would be interesting to know how much timber is wasted in Britain by the neglect of this precaution.

Chapter IV. gives a slight sketch of the enemies of the forest, of which, in the United States, fire and reckless lumbering are the worst, sheep-grazing and wind coming next. Snowbreak is less destructive than windfall. Landslips, floods, insects, and fungi, are sometimes very harmful. Lightning destroys many trees, and sometimes sets the wood on fire. Birds and squirrels often devour seeds so as to prevent natural regeneration, and porcupines and mice frequently kill young trees by gnawing their bark. Damage by game is not referred to, and Americans must be ever grateful that the rabbit pest has not been introduced into their country to work the terrible destruction it inflicts on agriculture and forestry in Australia and Europe.

The attacks of the different enemies of the forest are described in some detail, and protective measures suggested; whilst eleven pages are devoted to forest fires, the scourge of American and Canadian forests The Peshtigo fire of October, 1871, covered 2,000 square miles, killing about 1,500 people, including nearly half the population of Peshtigo, and doing damage to the extent of many millions of dollars. The means of defence against fires are discussed, and a plate given showing a fireline cleared along a railroad, with a double row of trees left between two cleared spaces, and intended to catch the sparks.

The author concludes this useful little work by stating that firelines cleared of all inflammable matter are very useful in checking small fires, and as lines of defence in fighting large ones. But without the men to do the fighting, they are of as little use against dangerous fires, as are forts without soldiers against invading armies.

Part II. constitutes a similar little volume, published in June, 1903; it is entitled "Practical Forestry," and deals with the work in the woods, the relations of the forest to the weather and streams, and gives a brief description of American and European forestry. It is also copiously illustrated.

W. R. Fisher.

Oxford.

FRENCH INDO-CHINA AND ITS TRADE.

The French possessions in the Far East, collectively known as Indo-China, are perhaps to most people, the least known part of Asia. Very little attention has been given to them by explorers and travellers, and still less by students of commercial affairs. The reason for this is difficult to find. Saigon, the chief port, lies less than three days from Hong Kong, and about the same from Singapore by the large steamships of the Messageries Maritimes Company, the subsidized French line from Marseilles. There is a steamer every two weeks to Bangkok, by the Messageries Fluviales de l'Indo Chine, which line also maintains regular service with the other ports of the colony, and there are many vessels at irregular intervals to Java and the Philippines. Indo-China is therefore accessible both to the tourist and the commercial traveller. The French possessions in the Far East, comprising Cochin China; Cambodia, Annam, Tonkin, and Laos, have a population of some 25,233,000, most of whom are Annamites. The Chinese are supposed to number about 150,000, but there are probably more. There are some 7,000 Europeans, chiefly French officials and soldiers. Cochin China and Tonkin are for the most part fertile deltas. Between them is Annam, a long mountainous tract of country with a narrow littoral on one side, and a wide, thinly populated hill district extending to the great river Mekong on the other. The climate in general, and especially in the plains, is extremely hot and humid. There

are two seasons, wet and dry. The chief rivers are the Kong (1,900 miles), which has been navigated as far as Chinese territory, although rapids and other obstructions are a hindrance to commerce; the Song-koi or Red River, which is ascended by small steamers as far as Larkai, in Yunnan, and the Black River. These three flow into the South China Sea. There are also many small rivers, which afford almost the only means of travel in the interior, where the luxuriance of the tropical vegetation makes travel by land an impossibility. The railways of Indo-China comprise lines from Haiphong to Hanoi, and thence to Langson, on the borders of the Chinese province of Kwang-Si (160 miles), from Saigon to Mytho (44 miles), and to Khanhao (24 miles finished), and Hanoi to Ninh-Binh. Lines soon to be completed are Thanh-Ba to Laokai (140 miles), thence to Yunnan-fu (220 miles). There is a line under construction from Hué to Tourane, and one from Saigon to Tanbrih in Annam is projected. Besides these, there are also tramways working. According to the American Consul at Bangkok, the immense increase in the total volume of the foreign trade of Indo-China is shown by the fact that, in five years exports have increased by more than 300 per cent. and imports by more than 500 per cent. About one-fifth of the trade is viâ Hong Kong. The principal productions of Indo-China are rice, silk, cotton, sugar, spice, tea, tobacco, pepper, and fish. By far the largest export is rice, which amounted in 1902 to the value of about £5,520,000. In 1904, 833,470 tons were exported, a gain over 1903 of £251,683 tons. The importation of rice into the Philippines from Indo-China is assuming very large proportions, and is rapidly increasing. In 1896 the importation was 3,380 tons, and 113,617 tons in 1903, while for the first six months of 1905, the amount was 94,291 tons. The chief imports are cotton goods, jute bags, and metals. The chief imports from France are machinery and supplies for public works and for the troops. Coal is extensively mined at Tourane and the coast of Tonkin. Gold, silver, tin, copper, and lead are also found. There is a cotton spinning mill in Hanoi, with 16,000 spindles, and other manufactures are being started. Indo-China is at present, however, and will long remain, an agricultural country. The clearing of shipping at the port of Saigon in 1904, was in vessels of all nations, 383 of 481,170 tons. To this number must be added the French ships of the Messageries Maritimes, Messageries Fluviales, Compagnie Nationale, and Chargeurs Réunis, bringing up the total to 608 vessels of 871,286 tons. Vessels sailing under the British flag numbered 158, with a tonnage of 235,917 tons. With the exception of the French mail steamers, the British have 49 per cent., and the French 19 per cent. of the total shipping of the port of Saigon. The chief drawback to the extension of the Indo-Chinese trade with countries other than France, is the preferential tariff, which acts against all foreign imports.

HOME INDUSTRIES.

Welsh Tin-plate Trade.—It is not surprising that operations in the Welsh tin-plate trade have lately been curtailed owing to the unprofitable outlook. In the middle of May, tin reached a record price, and although there has been sharp reaction, the quotation remains abnormally high. At one time last year tin could be bought at £129 5s. a ton. That was the lowest point of the year, and by the end of December the price had gone up to £167, or within £3 of the highest recorded price in the history of the trade, namely, £170 in 1888, when the Secretan Syndicate attempted to corner both copper and tin with disastrous results to themselves. Ever since the beginning of the present year the price has been rising until, on May 14th, it reached £212 10s. for cash, or a rise of £154 per ton as compared with the lowest price in 1897. Since then there has been sharp reaction, the price at the close of last week being no more than £194 per ton, but even that is £24 per ton higher than the highest price ever recorded before 1906. And probabilities point to the price going up again before very long seeing that the position remains one of restricted supplies, and growing consumption, necessarily resulting in a gradual exhaustion of supplies. Indeed shrinkage is becoming very rapid. In 1887, when the Secretan Syndicate began operations, the visible supply was about 11,000 tons; ten years later it had increased to 33,252 tons, when the price dropped as low as £58 10s. But since 1897 the contraction has been persistent, and now the visible supply has shrunk to below 12,000 tons, while the London stock, which in 1897 amounted to some 18,300 tons, was reduced at the end of April last to 1,513 tons. And this notwithstanding that the uses to which tin is now applied are constantly increasing. It is clear from these figures and facts that the shrinkage in supplies is due to the steady expansion of the legitimate trade demand and the absence of corresponding increase in supplies. Not only does tin remain the rarest of what are known as the "common" metals, considerable anxiety is felt as to the future production in the Malay Peninsula (the chief source of supply), where the tin is principally obtained from alluvial deposits. The reduced output is partly attributed to the fact that the Chinese miners have for some time been working on the poorer grades of ore, and partly too to the change which has taken place in the economic conditions. Nor have new deposits of importance been found in other parts of the world. China, it is thought, may eventually produce large quantities, and both Australia and Bolivia have increased their output to some extent in recent years; but no material increase to the world's output can be reasonably anticipated in the immediate future, and meantime the demand will continue to grow. For example, the requirements of the canning industry are on the increase, which necessarily implies a corresponding increase in the output of tin plates. Solder, too, requires a large percentage of tin.

The Variations in the Tin Supply.—It may be interesting to note the variations in the principal imports of tin and tin ore into the United Kingdom in recent years, and the sources of supply. The following Table supplies this information, and rests upon the figures to be found in the annual statement of the trade of the United Kingdom with foreign countries and British possessions, 1905, just issued:—

Countries whence Imported.	Tin Ore.	Blocks, Ingots, Bars, and Slabs.
	Tons.	Tons.
Germany, 1901	1,027	412
,, 1905	263	169
Netherlands, 1901	536	1,848
,, 1905	358	108
Chile, 1901	7,695	1,582
,, 1905	14,508	1,301
Total—Foreign countries, 1901	10,412	4,332
,, 1905	16,981	1,628
Straits Settlements, 1901	17	26,427
,, 1905	35	33,446
British India, 1901	—	1,456
,, 1905	—	600
Australia, 1901	93	3,145
,, 1905	695	3,479
Total from British possessions, 1901	110	31,065
,, 1905	825	38,137

It will be seen that the imports of tin ore from foreign countries increased by something over 60 per cent. in the five years, but that the imports of blocks, &c., were in 1905 considerably less than half the imports of 1901. The increase of tin ore from British colonies increased from 110 tons to 825 tons, and of blocks, &c., from 31,065 tons to 38,137 tons, the vast proportion of which came from the Straits Settlements.

The Cornish Tin Mines.—The present high price of tin and its probable maintenance naturally turns attention to Cornish tin mining. Thirty years ago the world's total production of tin was some 40,000 tons, of which over 13,000 tons were produced by Cornwall; that is to say, Cornwall supplied more than one-fourth of it. In 1884 the output of tin ore ("black tin") from the United Kingdom, practically from Cornwall, was 15,117 tons, in 1899 it had fallen to 6,392 tons, and last year it was only a trifle better at 6,742 tons. Of this the famous Dolcoath, Camborne, mine produced 1,705 tons, the East Pool and Agar 661 tons, the Carn Brea and Tincroft 657 tons, and the Wheal Grenville 622 tons. It is not so much that many of the Cornish mines are worked out, it is rather the archaic character of the management, which has been for the most part content with primitive machinery, and has looked askance at scientific methods. But with the price of tin at its present figures, and the practical certainty that it will remain very high for many years to come—the output from the Malay States is beginning to contract, and production in the Dutch East Indies shows serious falling off—it is not surprising to learn that movements are afoot for working the Cornish tin mines by more up-to-date methods, and it may be hoped that before very long there will be an appreciable increase in the home production of tin.

The New Commerce Act.—Home exporters will remember that the new (Australian) Commerce Act comes in force on June 8th and qualifies both the Trade Marks and the Copyright Acts. The Act relates mainly to imported and exported goods, and is concerned only remotely with the internal manufacture, sale, or distribution of manufactured articles. It is framed to make impracticable the importation of an article described, say, as an innocent soothing syrup for infants when really containing narcotics, or of boots largely composed of paper instead of leather. It contains also stringent provisions against manufacturers fraudently using the name or mark of other makers having an established reputation, and against the export and sale abroad of say "pure grape brandy" which is not really and wholly such. The Act follows the British Merchandise Act in making the Customs entry a trade description, and thus renders the exercise of the utmost accuracy necessary in the drafting of invoices.

Mining Machinery in South Africa.—The hold of American and continental firms on the mining machinery trade of the Rand, which is indisputable, is largely due to two factors—the amount of continental capital invested in the mines which enables influence to be asserted in the disposal of the orders, and the large number of American engineers employed in the industry. These naturally prefer the machinery and plant of the United States, with which they are familiar, to those of the United Kingdom, with the necessary result that the orders go to America. Similar tendencies resulted from the early settlement of foreign engineering and merchant firms in Johannesburg, and in certain of the coast towns. And a like sequence of cause and effect may occur at Gwelo, in Rhodesia, if English machinery firms do not take warning by past wants and protect it. A firm established at Gwelo calls attention in an American newspaper to the favourable opportunity which exists for the establishment of an engineering firm. It is, the firm says, the centre of 11 gold belts, and 36 mining proprietories are being worked, turning out three-fourths of the total Rhodesian gold output. It has hitherto drawn its supplies from

Buluwayo, 113 miles distant, but since the reduction of the railway rates to Beira, it is placed in a far better position to compete for the trade of the country around about than Buluwayo, and, states the American firm, "Any enterprising firm starting here could, in a few months, capture most of the trade of the country, as it would have the advantage of about 3s. 6d. per 100 lbs. in railway rates."

Motor-cars in India.—It is to be hoped our motor-car manufacturers will not let the Indian market slip into the hands of the foreigner. In the past fiscal year the imports rapidly increased. Motor-cycles share with motor-cars popular favour, the total imports of both into Bombay last year being of the value of over 1,000,000 rupees. Motor-cars alone were imported into Calcutta last year to the number of 120. The rage for auto-mobilism which has seized upon the wealthier natives is responsible for most of the increased imports, but public services of cars are also being studied. Motor-car races are becoming very popular. The car required for the market is one that is strong, simple in design and working, fitted with fairly powerful engines to negotiate the rough roads of the country, and not necessarily of high speed, the natives attaching little importance to speed. The ordinary four-seated car is preferred. The market has great expansive capabilities, but British manufacturers must look after it well if they are to hold their own against the foreign low-priced article which has already made its appearance. Prior to 1902 the exports of motor-cars from the United Kingdom to India were included in "Carriages, other sorts," but since then they have been given separately. They show the following results so far as India is concerned:—

	1904. Number.	1905. Number.
Bombay	85	204
Madras	13	30
Bengal	34	87
Burmah	29	25

It will be seen that the exports of motors to India proper increased considerably in 1905, as compared with 1904, but the total number sent out to India was insignificant as compared with what may be expected in a few years time if the market is carefully worked. It may be noted that the total number of motor-cars exported from the United Kingdom to British possessions increased from 480 in 1904, to 833 in 1905, the best market being the Australian, which took 132 in 1905, against 106 in 1904. New Zealand took 97 in 1905, as against 75 in 1904. Only a very few cars have gone to Canada, since the export was not large enough to come under a separate heading, being included in "other British possessions." The export to the Cape was actually less in 1905 than in 1904—59 as against 60—but Natal increased her import from 26 to 89.

CORRESPONDENCE.

THE DEVELOPMENT OF WATER-MARKING.

I have been deeply interested by Mr. Beadle's paper on "The Development of Watermarking in Hand-made and Machine-made Papers," and particularly by your own reference to the Woodbury process, or "photofiligrane," because I was not previously aware who had originated this beautiful method of producing designs resembling watermarks in paper. You express a doubt as to the invention having any practical application; but here, apparently, as in so many other instances, we find a Britisher making the fundamental discovery and the application of it benefiting some continental country only. This process is used pretty extensively in this country and Austria, and I have seen many examples of most beautiful and artistic work, not executed merely for the pleasure of the thing, but on the commercial scale. Many of the best German, Austrian, and Italian notepapers of the qualities most in demand are so marked. The gelatine relief is made on stout tough cardboard (of course any number can be produced cheaply) and passed together with the paper to be impressed through a machine very similar to the plate-glazing calender. This has led to other methods of attaining similar results especially in simple line work, as the fixing of designs in thread, paper, &c., on the cardboard and covering the whole with a sheet of thin paper pasted on, this then serving instead of the gelatine relief.

Mr. Clayton Beadle has held strictly to his definition for the purposes of his paper; but between the real "watermark" and the Woodbury process, there lie gradations which belong more or less to both classes. One of these methods of German origin, and largely used in this country (Behrend's, German Patent No. 149174), consists of a series of small type-wheels to bear the designs and mounted above the top roll of the second press so that they rest on the still very moist paper where it is in close contact with the roll and sufficient pressure is obtained by weighted levers to cause the type-wheels to rotate with the press roll and paper, and to mark the latter by thinning it where the pressure is greatest, *i.e.*, under the design. When papers so marked are examined it is found that, as with the dandy roll, the fibres are, to a certain extent, displaced. The method also avoids the necessity for large stocks of dandies. I have produced similar results also on the first and second drying cylinders.

Referring to Mr. Walter Young's remarks, I may say that in some mills it has been the practice for a long time to keep only one dandy for several marks where only part of the design varies; the variable portion of the design being worked on a piece of wire cloth which is sewed into a corresponding space cut out of the dandy cover. Mr. Marshall's

objections to this method for laid rolls may probably hold good. I have used it only for wove rolls.

J. MELROSE ARNOT.

The Secretary.

OBITUARY.

F. C. DANVERS.—Mr. Frederick Charles Danvers, late Registrar and Superintendent of Records at the India Office, died on the 17th inst., at Broad-oaks, Addlestone, Surrey. He was born at Hornsey 1st July, 1833, educated at Merchant Taylors' School, King's College, London, and Addiscombe, and for two years studied as a civil and mechanical engineer. He joined the clerical establishment of the East India House in 1853, but in 1858 he was transferred to the newly formed India Office. In the following year he was sent to Liverpool and Manchester to report on Traction Engines, with a view to their being used in India. He joined the Public Works Department of the India Office in 1861, and subsequently rose to be senior clerk and then assistant secretary. In 1884 he was appointed Registrar and Superintendent of Records, an office which he held until he retired from the Government service in 1898. He was appointed to Lisbon for the purpose of examining the Portuguese Records relating to India in 1891-92, and on similar duty to the Hague 1893-95. He wrote many articles and reports on Indian subjects, but his most important work was entitled "The Portuguese in India: A History of the Rise and Decline of their Eastern Empire," in two large octavo volumes. Mr. Danvers was elected a member of the Society of Arts in 1890, and was a member of the Indian Section Committee. He read two papers before the Society—one on "Agriculture in India'" (1878), and the other on "The India Office Records" (1890). For each paper he received the Society's silver medal.

GENERAL NOTES.

TRADE WITH ARGENTINA.—It may be gathered from Mr. Consul Ross's report on the trade of the consular district of Buenos Ayres for 1905 (No. 3557, Annual Series), that Argentina still looks to the United Kingdom to improve her stock. In 1905 the imports of blood stock were as follows:—Cattle, 1,400; horses, 500; sheep, 5,500; pigs, 180. Of these the United Kingdom supplied practically all the cattle, sheep, and pigs, and also half of the horses. 350 sheep were from New Zealand. The highest price paid for an imported bull was £3,300, given for Durham, bred at Windsor. In general trade with the Republic the United Kingdom is not quite holding her own. Her percentage of the imports in 1905 was 33·3 as compared with 34·4 in 1904, Germany increasing from 13·3 to 14·2, and the United States and France in about the same proportion. Of imports from Argentina, the United Kingdom took 13·9 in 1905, as against 13·8 in 1904; but Mr. Consul Ross points out that the share of the export trade taken by the United Kingdom is larger than statistics show, as many cargoes are shipped "to order." More than one-third of the export trade is dealt with in that way. According to the British Board of Trade returns for 1905, 50 per cent. of the wheat exported from Argentina in 1905 "to order" was landed in the United Kingdom, 60 per cent. of the maize, and 80 per cent. of the linseed.

CO-OPERATION, &C. IN NORWAY.—In his report upon the trade of Norway for 1905 (No. 3555, Annual Series), Mr. Edward Gray, the acting British Consul-General, says that the co-operative system of farming seems to gain ground in Norway, especially in the east, where a number of associations have been formed under a central association in Christiania, for the purchase of supplies. There are also signs of co-operation in the butter trade, and in the egg trade, and attempts are being made to organise the supply to Christiania of fruit, berries, and vegetables. 1905 formed no exception to the succession of uneven years for the Norwegian fisheries. In some cases the usual favourite districts proved failures, while in other hitherto little-frequented neighbourhoods fish were plentiful, though they hardly compensated for loss elsewhere. Efforts have been made by the authorities to give a helping hand in the form of loans for the purchase of more up-to-date fishing craft, and 159 steam fishing vessels were bought in 1905; but motor cutters seem growing in favour. In 1903 there were only some eight or ten of them in Norway for fishing purposes that could be called modern. Their number is now estimated at over 150. Several British-built smacks have also been bought for combined coasting trade and fishing, especially for mackerel.

A NEW KIND OF RUBBER TREE.—Mr. Consul de Lemos refers, in his report on the trade and commerce of Ciudad Bolivar (No. 3558, Annual Series), to what he describes as "a new and here previously-unknown kind of rubber tree discovered in the extensive forests of the Caura district," situated from 150 to 200 miles from the port of Ciudad Bolivar. Sample lots of the rubber produced from this tree have been sent to London, New York, and Hamburg, and have realised from 3s. to 3s. 6d. per lb. This price is remunerative, as good facilities for transport by water exist. Unfortunately as yet no efficient system of tapping the trees has been discovered, as

by the method of tapping applied to the india-rubber trees in the Rio Negro district the milk does not exude freely. The result is that the collectors fell the trees in order to be able to tap them all along the trunk, following in this respect the system they employ for collecting the Balata rubber. This must, of course, bring about the eventual exhaustion of the forests, which in the case of the Balata tree is already beginning to be felt.

TRADE WITH MOROCCO.—In his report upon the trade of Morocco just issued (No. 3547, Annual Series) Mr. Consul White says that the statistics accompanying the report cannot be taken as quite accurate as regards imports. It seems that no information is to be obtained from the Moorish Customhouses, and no statistics whatever are published by the Moorish Government. The latter are labouriously compiled from ship's manifests and bills of lading obtained from the various steamships' agents. These documents, however, afforded but scanty information, the exact class and quality of the goods imported not being given, nor even their weights or values in most cases. The compiler is thus dependent upon such information on these points as the merchants themselves are willing to give, and, though generally very obliging in this respect, they cannot be expected to give full detailed information as to the goods they have imported during the year. The manifests and bills of lading, moreover, contain no mention of the country of origin of the goods imported, which have consequently to be entered as coming from the country in which they were shipped, although in many cases they were in transit from another country. Thus the figures of British trade are swelled to a small extent by goods transhipped at Gibraltar for Tangier, such as petroleum and flour. French figures embrace Italian raw silks, Swiss muslins, &c., and German figures include Belgian and Austro-Hungarian sugars, cloths, porcelain, and glass. The figures as given in the past year show that the United Kingdom and France who between them hold nearly three-fourths of the whole trade, were the greatest sufferers through the general depression of trade, whilst German trade, which has lately been vigorously pushed, shows a slight increase in amount, and a considerable increase in its ratio to the total trade.

MEETINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday Evening, at 8 o'clock :—

MAY 29.—"Glass Cutting." By HARRY POWELL.

*** This paper will be read at the Whitefriars Glassworks, and will be illustrated by a demonstration of processes of glass-cutting.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

LECTURE III.—MAY 28.—The heraldic group, or achievement of arms—How proportion is influenced. *Supporters*—Their derivation — Satisfactory proportion—Their pose in relation to the other armorials and to the containing spaces—Other accessories—Crowns and coronets—The use of the cap—Insignia of knighthood. *Badges and Devices*—Their suitability to present decoration—Royal badges—The Union badges—Badges of the Prince of Wales. *Banners*—Proportion — Arrangement of the bearings — The Royal banner—The composition of the Union Jack—Schemes of decoration—Certain tendencies in modern heraldry—The study of good examples—The spirit of the old work—Conclusion.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 28... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George W. Eve, "Heraldry in Relation to the Applied Arts." (Lecture III.)

Farmers' Club, Whitehall Rooms, Hotel Metropole, S.W., 3½ p.m. Discussion on the Land Tenure Bill as amended in Committee.

Royal Institution, Albemarle-street, W., 3 p.m. 5 p.m., General Monthly Meeting.

Surveyors, 12, Great George-street, S.W., 3 p.m. Annual General Meeting.

TUESDAY, MAY 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Harry Powell, "Glass Cutting." This meeting will be held at the Whitefriars Glassworks, and will be followed by a Demonstration of Processes of Glass-cutting.

Royal Institution, Albemarle-street, W., 5 p.m. Colonel V. Balck, "Northern Winter Sports." (Lecture I.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 11 a.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Great Flower Show, Inner Temple-gardens, E.C , 12 noon.

WEDNESDAY, MAY 30...British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, MAY 31...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m., Prof. W. J. Sollas, "Man and the Glacial Period." (Lecture II.)

FRIDAY, JUNE 1...United Service Institution, Whitehall, S.W., 3 p.m.

Royal Institution, Albemarle-street, W., 9 p.m. Prof. H. Moisson, "L'Ebullition des Métaux."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Mr. G. W. Eve, "Heraldry."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square. W.C., 8 p.m.

SATURDAY, JUNE 2...Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. Maeneile Dixon, "The Origin of Poetry."

Journal of the Society of Arts.

No. 2,793. VOL. LIV.

FRIDAY, JUNE 1, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ALBERT MEDAL.

The Council have awarded the Albert Medal for the present year, with the approval of His Royal Highness the President, to Sir JOSEPH WILSON SWAN, F.R.S., "For the important part he took in the invention of the incandescent electric lamp, and for his invention of the carbon process of photographic printing."

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The central portion of the gardens only will be used. The gardens will be illuminated with coloured lamps, and also by the Kitson incandescent oil light. The Conservatory and the Club-house will be open.

The reception, by Sir Owen Roberts, M.A., D.C.L., F.S.A., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

The Tropical-house, containing the giant water lily (Victoria Regia), and other interesting tropical plants, will be open to visitors.

An exhibition of growing and cut roses and other flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

A selection of music will be performed by the string band of the Royal Artillery in the Conservatory, and by the band of the H.M. Scots Guards in the gardens, commencing at 9 o'clock.

Two performances of selections from pastoral plays will be given in the gardens by Mr. Patrick Kirwan's Idyllic Players at 9.30 and 10.30 p.m.

A concert and entertainment by members of Mr. Kirwan's company of Idyllic Players, with choruses by children (Bellew and Stock's choir), will be given in the Club-house at 9.45 and 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

CANTOR LECTURES.

On Monday evening, 28th ult., Mr. GEORGE W. EVE delivered the third and last lecture of his course on "Heraldry in Relation to the Applied Arts."

On the motion of the CHAIRMAN, a vote of thanks was passed to the Lecturer for his interesting course of lectures.

The lectures will be published in the *Journal* during the autumn recess.

APPLIED ART SECTION.

Tuesday evening, May 29th. The meeting of the Applied Art Section was held at the Whitefriars Glass Works, when a paper was read by Mr. HARRY POWELL, on "Glass Cutting."

After the reading of the paper the company inspected the show-rooms containing specimens of cut and other table glass and then proceeded to the glass-houses where the various processes of glass manufacture were in operation, among which the work in glass cutting was of special interest in illustrating the paper.

On the motion of Mr. LEWIS DAY, Vice-President of the Society, a hearty vote of thanks was passed to Mr. Harry Powell for the interesting paper he had read, and to Messrs. James Powell and Sons for the interesting exhibition which had been provided.

Mr. Powell's paper will be printed in a future number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday evening, May 8; ALAN S. COLE, C.B., in the chair.

The paper read was—

DAMASCENING AND THE INLAYING AND BLENDING OF METALS.

By SHERARD COWPER-COLES.

"The art of a thing is, first its aim, and next its manner of accomplishment."—C. N. BOVEE.

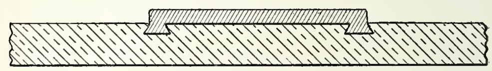
SYNOPSIS.

Introduction — Historical sketch—Damascening—Niello work—Ether process—Parcel or close-plating process—Fusion process—Electrical process — Hot lead process —Tarsiaturan work—Description of new process—Results obtained—Construction of plant—Working conditions—Conclusion.

INTRODUCTION AND HISTORICAL SKETCH.

The ancient and beautiful art of damascening, which is probably due to the East, consists of inlaying one metal with another metal or metals, usually silver or gold, upon iron or steel in the form of wire or strip, into recesses or lines, which are dovetailed or undercut—that is, wider at the base than on the surface—with a specially-constructed tool, the whole surface being finally smoothed and polished. When broad bands of metal have to be laid on, the edges of the band are grooved or incised, as shown in Fig. 1, saving much labour and economising the precious metal to be inlaid.

FIG. 1.



METHOD OF LAYING ON BROAD BANDS OF METAL.

Damascus sword blades must not be confused with damascening, which is a distinct art. Their peculiar variegated watered appearance, and the method by which the structure is produced, has been a matter of speculation. Dr. Percy, in his book on the "Metallurgy of Iron and Steel," explains it thus:—

"The damasked portion is due to the difference in coloration, resulting from the action of acids on iron and steel, the surface of the former being left with a metallic tissue, and that of the latter being left coated with a black firmly-adherent carbonaceous residue.

"By suitably piling together bars of iron and steel, welding them, and then drawing them out under the hammer or otherwise, patterns of various kinds may be produced, just as it does in the case of glass, by heating together variously-coloured pieces of glass and drawing them out into rods."

In the thirteenth century, Theophilus the Monk, when writing on artistic handicrafts, described the process of damascening; in Persia, China, and Japan it was practised before that period, with most artistic results. In the British Museum can be seen the remains of the celebrated Etruscan car, embellished with fine examples of damascening.

This rich method of surface ornamentation which can also be very delicate in design, was practised in the East long before it was introduced into Europe from Damascus, the chief city of the Moors. During the sixteenth century, in the time of Cellini, it was freely practised in Italy, being specially employed for the decoration of weapons and armour. The Arab work done by the Moslems in Northern India, is some of the most beautiful. In Kashmir, vessels of copper and brass are very effectively inlaid with tin, an art which, like many decorative arts, appears to have

originated in Persia. The Arabic-speaking people, the Chinese, and the Japanese, are fortunate in possessing a system of written characters which are beautiful in themselves, and readily lend themselves to damascening work. During the Dark Ages the art appears to have been lost, except for some church gates at Rome, made in 1070, at Constantinople.

I cannot do better than quote Mr. W. L. Hildburgh, who made a communication to this Society at the beginning of this year, on the production of metal inlaid work at Cairo, (see *ante*, p. 215), which gives a detailed account of the present-day methods of manufacture of damascened work, the process being practically the same as that employed by other nations from time immemorial :—

"There is a considerable demand at Cairo each year for brasswares of various kinds, in the form of utensils and ornamental objects. Amongst these wares the richest in effect and that requiring the most skill for its perfection, is inlaid with silver or gold. The greater portion offered for sale in the Cairo bazaar are, howerer, made in Damascus, where labour is considerably cheaper than in Cairo, and where many more workmen are engaged in the production. While in Cairo it is said, there are only about thirty men skilled in inlaying, in Damascus there are several hundred; on the other hand, the quality of the Damascus work is said to be inferior to that of the best Cairene . . . . The whole of the decoration is applied in the form of wire, which is afterwards flattened by hammering. The metal for the body is usually brass upon which may be silver, less frequently copper, or silver gilt, and rarely, on account of its cost, gold; generally the copper and gold are used only in conjunction with silver to enhance its effect. The objects decorated are mainly ewers, jugs, trays, coffee pots and cup-holders, hanging lamps, boxes and the like. Some of the pieces are of considerable size, elaborately covered trays 24 to 28 inches in diameter being occasionally to be found.

"The faults to be found in damascened objects are as follows :—The wire is missing from parts of the prepared surface, or is loose, due to imperfect preparation, this being especially liable to occur with cast brass bodies. The cutting off of the wire is carelessly done, giving a stepped appearance to the outlines of a broad surface. The holes are too deep for the size of the wire used, so that the silver lines have wavy edges. The parallel lines of holes for a broad surface are too far apart for the wire used, cracks showing over the silver surface, or even irregular lines of brass being visible. Occasionally, when the brass has proven bad locally, the parts which have refused the wire are tinned, giving them a dull flat, leaden appearance, observable at a considerable distance."

An easier and less expensive and effective method of inlaying than the process just described of inserting gold and silver wire into a dovetailed groove prepared for its reception, is to hatch in lines with a graver, and hammer the gold and silver or other precious metal into the roughened surface. The ornament for the most part consists of threads of gold, and the whole surface is finally burnished, which restores the ground, when not covered with gold, to nearly the original polish. When the pattern has many solid parts, or few or no thin lines, only the surfaces covered by those parts is roughened, and the gold applied; the labour of burnishing is thus saved. Very often, in this case, the gold ornaments are in relief, and require chasing after the necessary hammering to make them adhere. There is another modification which is occasionally used; it consists of pricking the outline only of the ornament in such a manner as to make little rough teeth, to which the gold is fixed by pressure.

I will now show you some lantern slides illustrative of Indian, Italian, Spanish, Saracenic, Persian, and Japanese damascening. The first is a specimen of Italian work, about 1550, made for the Royal Family of Savoy, and is a mirror of burnished metal, in a stand of steel damascened in gold and silver. The frame is of architectural design, supported on scrolls, which rest on a square box, with scrolled angles and feet. The whole is covered with medallions of classical subjects, arabesque, cartouche, &c., in gold and silver. At the back of the mirror is a religious subject, with "The Saviour and the Angels," in niches; the whole is surmounted by a group of Venuses and Cupids. The next is a Spanish gauntlet, sixteenth century, damascened with military trophies, palm branches and wreaths in gold, and with foliage, the knots are gold and silver. The following slide is a Japanese dish, inlaid in various diapers in silver, and a border of leaves and grapes. In the centre is the medallion head of a man holding his hands to his cheeks, surmounted by a similar border, from which six petals diverge, inlaid with flowers in gold and silver. The next illustration is probably the work of Saracenic craftsmen settled in Venice; the bronze salver is engraved and damascened with gold and silver, and the interstices filled with black lac; in the centre are the enamelled arms of the family of Verona. Now follows a specimen of Indian work; the ewer

is damascened on silver and gold, dated 1400 A.D. The metal on which the gold and silver is inlaid is a zinc alloy, blackened by pickling in a solution, or applying, in a pasty condition, of chloride of ammonia, common salt, nitre, and sulphate of copper. The alloy employed by different craftsmen is found to vary considerably; the following is a typical analysis:—

Lead	1·437
Tin	trace.
Iron	·039
Copper	6·905
Zinc by difference	91·619
	100

The next illustration is another specimen of Indian work, about 1770, and is the base of a water pipe or hookah, damascened with gold and silver. The final illustration is a Persian shield, damascened with gold and silver, chased with flowers, animals, and an inscription.

I will now pass on to niello which is similar to damascening, only inasmuch as the metal to be ornamented has to be engraved, it is filled with a metallic sulphide instead of being beaten in metal. The process consists of incising lines on the metal as in copper-plate engraving, and filling them with a compound of sulphur, silver, copper, lead, and borax. In this way very effective results are obtained, the finished work having the appearance of a drawing in black on a metal plate. The word "niello" is derived from "niger," and refers to the colour of the enamel. The modern copper or brass door-plate, filled with black enamel, is really niello work.

Our knowledge of the process and materials employed in niello work is largely derived from Eraclius the Roman, a writer of about the eleventh century. The goldsmiths of Florence, in the middle of the fifteenth century, were in the habit of ornamenting their works by means of engravings, after which they filled up the patterns produced with a black enamel, made of silver, lead, and sulphur, to make the design more visible by the contrast of enamel and metal.

The monk Theophilus, already referred to, also mentions niello work. His recipe is silver one part, copper one-third part, and lead one-sixth part, all to be fused together with yellow sulphur by melting in a crucible, the composition, after cooling, being powdered, and applied to the metal at a low heat, with a flux of parachas gum, which was probably borax. The procedure was as follows:—The design, having been cut with a sharp graving tool on the smooth surface of the metal, which was usually silver, but occasionally gold, a solution of borax, to act as a flux, was brushed over the metal plate and thoroughly worked into its incised lines. The powdered sulphide compound was then shaken on to the plate so as to completely cover all the engraved pattern. The plate was then carefully heated over a charcoal fire and fresh compound added, as the powder fused, upon any defective places. When the powder had become thoroughly liquid so as to fill all the lines the plate was allowed to cool, and the whole surface was scraped to remove the superfluous niello, leaving only what had sunk into and filled up the engraved pattern. Last of all, the nielloed plate was very highly polished till it presented the appearance of a smooth metal surface enriched with a delicate design in fine gray black lines. This process was chiefly used for silver work on account of the vivid contrast between the whiteness of the silver and the darkness of the niello. As the slightest scratch upon the metal received the niello, and became a distinct black line, ornament of the most minute and refined description is easily produced.

Niello work is responsible for having originated plate engraving. The artist or craftsman, when executing a piece of niello work, was in the habit of making a sulphur cast of his niello in progress, on a matrix of fine clay, and filling in the lines in the sulphur with lamp black, thus enabling him to judge of the effect obtained by his engraving process. At a later period it was discovered that a proof could be taken with damp paper, by filling the engraved lines with ink, and wiping it off the surface of the engraved plate, sufficient pressure being applied to make the paper enter the lines containing the ink. This was the beginning of plate printing, but the value of the discovery was not realised until some considerable time afterwards. It was merely employed as a convenient method by niello engravers of proving their work and saving the double process of making a sulphur cast.

Statuettes, fibulæ, and the centre of silver dishes decorated with niello work, combined with part-gilding, were apparently in considerable favour during the first few centuries of the Christian era. In 1793, some beautiful specimens of niello work were found near the Esquiline-gate, belonging to a Roman lady.

In the time of King Alfred there appear to have been a number of gold ornaments decorated with niello.* The art of niello work is still kept up in Siam, Turkey, Burmah, and Italy, but is most largely practised in the Caucasus, for decorating all classes of metal objects. I will now show you a lantern slide of a silver and gilt niello cup, engraved with figures, roses, and festoons, made in Russia 1792; the snuffers in the fore-ground are French damascened work, about 1700; they are blued steel, inlaid with gold.

There are other minor processes employed for inlaying and decorating metals, which I will briefly describe.

Ether Process.

The ether process consists of using a composition of sulphuric ether, and nitro muriate of gold, which are mixed together, the ether by degrees becoming impregnated with nearly the whole of the gold, and retaining it for a long time in solution. The ether thus charged, is painted on the surface of the ornament with a camel's hair brush. After evaporating the ether by heating to a temperature of 150° F., the gold is finally brightened with a burnisher; the coating thus obtained is very thin, and is only suitable for decorating articles not subjected to wear.

Parcel or Close Plating.

Consists of onlaying flat pieces of metal on the surface to be decorated, in much the same way as veneering, the metal being attached by means of a low melting point solder. A modification of this process consists of cutting out the same patterns in two different coloured metals, and interposing the portions removed.

Fusion Process.

A process occasionally employed for decorating metallic surfaces consists of engraving or etching on a flat surface the desired design, and then running into the sunken portion molten metal. This process is very costly, and is only applicable to flat surfaces.

Electrical Process.

In the electrical process those parts of the metal which it is intended should not be inlaid are stopped off with a suitable composition of resist, such as a varnish or beeswax, and gold or silver or other metal or metals are deposited by the usual method of electro-deposition, the plate having been previously etched, if the pattern is to be level or flush with the surface decorated, or the pattern or design can be raised by omitting the etching process. The illustration now thrown on the screen is a zinc plate, etched and inlaid with copper by electro-deposition, and the next is a copper plate, with a raised design in zinc electro-deposited.

Lead Process.

In the lead process a design or picture is etched by means of acids, either by hand or by photography, on a thin plate of steel or other metal. The etched side of the plate is then brought into contact with molten lead, and when the play of colours produced on the plain side results in the desired effect, the plate is immersed in cold water or oil. In this way, heat having been conducted through the various portions of the plate at rates inversely proportional to their thickness, yields colour due to different thickness of oxide on the plain surface, which represent the etched design on the reverse side. By such a process beautiful colour effects can be obtained, but the result is not permanent. Some specimens of this work will be found on the table.

This brief description of the allied porcesses would not be complete without a reference to tarsia or wood mosaics, or marqueterie, which is often combined with metallic inlay work. Tarsia work is the same as damascening in principle, but applied to wood, that is, wire is hammered into grooves cut in the wood to receive them. In a recent development in tarsiaturan work, wood veneer is cut out corresponding to that portion of the pattern that is ultimately to be represented by metallic inlay, and fastened down on to a sheet of metal provided with teeth for holding purposes. The back of the sheet is protected with varnish, and the whole is placed into a copper electro-depositing solution. A deposit is thus obtained on the bare metal, which eventually becomes flush with the surface of the surrounding veneer. Buhl work is also similar in many respects, but is chiefly applied to inlaying of brass and tortoiseshell. The brass is laid on to a wood base in the form of strips, and the tortoiseshell inlaid between.

New Process of Inlaying and Ornamenting Metallic Surfaces.

I will now describe to you a new process, which is based on a discovery made by my-

* Those who wish for further information regarding Niello work should read a paper delivered before this Society by Mr. Cyril Davenport. (*Journal*, vol. 48, p. 245.)

self about five years ago, when conducting some experiments on the annealing of iron, viz., that metals in a fine state of division, to a temperature several hundred degrees below their melting point, in contact with a solid metal, volatilise, or give off the vapour, that is in the form of a powder, when heated which condenses on the solid metal placed in the powdered metal.

FIG. 2.

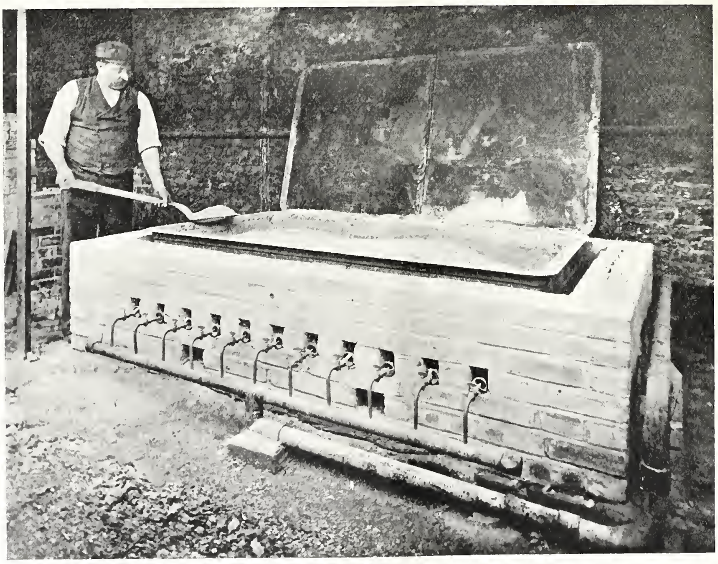
COPPER TRAY READY FOR BAKING.

This discovery has recently been turned to account for the inlaying and ornamenting of metallic surfaces, enabling results to be obtained similar to damascening, but with the additional advantage that there is no risk of the metals finally separating, as is often the case in damascening, as will have been observed in some of the illustrations shown to-night.

The new process also enables a variety of effects to be obtained, and a number of metals to be blended together which has hitherto been impossible, and alloys of many colours and tints to be obtained in the one operation of baking. The thickness and depth to which the metals are to be inlaid and onlaid, can be controlled at the will of the operator.

The *modus operandi* of the process consists in coating the article with a stopping-off composition, those portions which are to be inlaid being left exposed, see Fig. 2. The composition is about the consistency of cheese, so that it can readily be cut with a knife; the design is traced with a sharp edged tool, and those portions to be removed are lifted and cleared away. The object thus prepared is placed in an iron box, containing the metal which is to be inlaid in a powdered form. If zinc is the metal to be inlaid, zinc dust is the powder that will be employed, which is a product obtained direct from the zinc smelting furnaces. The iron box holding the powdered metal, and the objects to be ornamented,

FIG. 3.



GAS-HEATED OVEN.

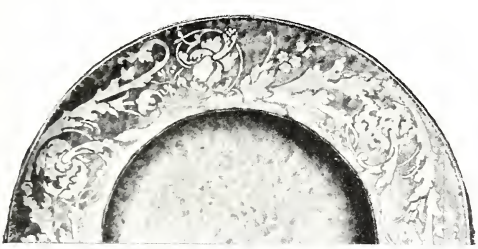
is then placed in a suitable baking oven, and heated to a temperature many degrees below the melting point of zinc, which is 686 Fahr., so that the temperature to which the zinc dust is heated is about 500° Fahr. My assistant, Mr. Gardner, will now take four small copper plates prepared with a scroll design and place them in an iron box, and fill

FIG. 4.

COPPER TRAY INLAID WITH ZINC AND BRASS.

it with zinc powder, and heat the box in a small gas furnace, matters being so arranged that the operation of inlaying will occupy about ten minutes, by which time I shall have concluded this paper. He will then open the box and show you the results obtained. The time and temperature is regulated according to the thickness and depth of the inlaying which is required to be obtained, and varies

FIG. 5.



COPPER DISH IN WHICH THE HAMMER MARKS UPON THE COPPER CONTINUE TO SHOW IN THE ZINC INLAY.

from a few minutes to several hours. A little experience soon teaches the operator the best time and temperature necessary for obtaining given results with different metals. When the article has been baked for a sufficient time the box, after preferably being allowed to cool, is then opened, and the article removed, and brushed with a stiff brush, to remove the stopping-off composition which has become loosened during the process of baking; the process of stopping off and baking can be repeated several times when it is desired to inlay two or more metals. It will, no doubt, have occurred to many of you that the metal box containing the powdered metal will rapidly become thickly encrusted with metal, but this is found not to be the case, the reason being that the metal box is hotter than the powdered metal. A useful type of furnace or baking oven for

FIG. 6.

COPPER TABLE TOP INLAID WITH ZINC.

general work, such as panels, trays, &c., is shewn in Fig. 3, and consists of a wrought iron box, 8 feet long and 4 feet broad, one foot deep. The box is half filled with zinc dust, and the articles to be baked are placed in the zinc dust, and well covered over with it, a lid placed on the top of the box, and over this an iron frame work, carrying fire bricks, and with a small central flue, to draw

FIG. 7.

GONG INLAID WITH ZINC.

the heat from the burners up the sides of the box and over the top, to ensure even heating. Such a furnace can be constructed at a cost of about £30 complete. Damascening produced by this method is of a more permanent character than the older method. There is no possibility of separation, as the metals are alloyed together and the inlay can be carried to any depth, and it is found that the inlaying metal, in the case of zinc, is very much harder than the brass or copper into which it is inlaid.

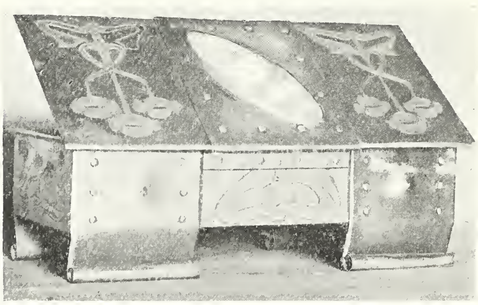
A feature of considerable importance is that a variety of colours and alloys can be obtained

in the one operation of baking. I will take for an example a copper tray, which it is desired to inlay with zinc (Fig. 4), and at the same time to convert certain portions of the copper into brass. This can be done by varying the thickness of the stopping-off composition, and by baking at a somewhat higher temperature than would otherwise be employed. The result is that certain portions can be converted into golden-coloured brass, the other portions remaining unalloyed copper. In the example taken, certain portions of the foliage and birds are a combination of brass and copper. Fig. 5 is a hammered copper dish, inlaid with zinc, in which a different effect is obtained, as the hammer marks continue to show in the zinc inlay. Fig. 6 is a copper table top inlaid with zinc; in this case the zinc inlay is smooth, and copper-hammer marked. Fig. 7 is a gong inlaid with zinc, surrounded with a line of brass. Fig. 8 is a copper dish inlaid and onlaid with zinc, the zinc being raised as much as 1-16th of an inch above the surface of the copper. Fig. 9

FIG. 8.

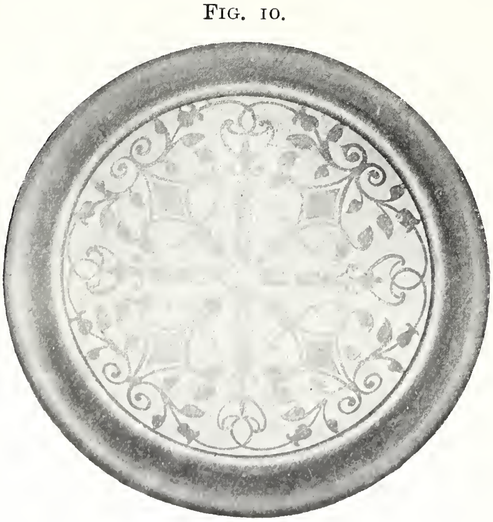
COPPER DISH INLAID AND ONLAID WITH ZINC.

FIG 9.



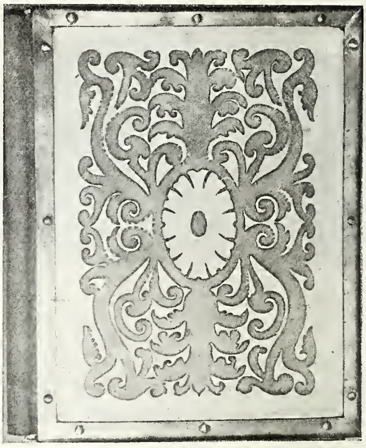
IRON BOX INLAID WITH ZINC AND ENAMEL.

FIG. 10.



COPPER AND ZINC ALMS DISH.

FIG. 11.



BOOK COVER, COPPER AND ZINC.

FIG. 12.

COPPER LIQUEUR TRAY INLAID WITH ZINC AND BRASS.

is an iron box inlaid with zinc and enamel. Fig. 10 is an alms dish; the whole of the surface was burnt with zinc, and the pattern etched down to the different alloys formed, intermediate between the zinc and brass, so as to obtain a variety of colours. Fig. 11, which is a book-cover, is done in a similar manner, with the exception that the outline of the pattern has been chased and the whole of the design etched down to the copper. Fig. 12 is a copper liqueur tray, inlaid with zinc and brass, the zinc pattern being considerably raised.

Without exception, the samples I have shown you by means of the lantern are two

FIG. 13.

COPPER TEAPOT INLAID WITH ZINC AND BRASS.

metals giving a decided contrast, such as copper and zinc, as the more subtle contrasts between zinc, tin, aluminium, nickel and cobalt, and similar coloured metals are difficult to photograph, but a number of specimens will be found on the table.

The new process is not confined to flat surfaces, but can be readily applied to raised surfaces. Fig. 13 is a copper tea-pot inlaid with zinc and brass. Fig. 14 is a coal-vase, made of brass and copper, inlaid with zinc. Fig. 15 is a flower vase, inlaid with zinc, which is partially engraved. This process is also adaptable to the finest work as well as very bold work, as illustrated by Fig. 16, which is a small copper panel 4 inches by 3 inches, inlaid with zinc, and Fig. 17 is a small iron panel $3\frac{1}{4}$ inches by 2 inches, inlaid with zinc. The coat of arms of Charterhouse

FIG. 14.

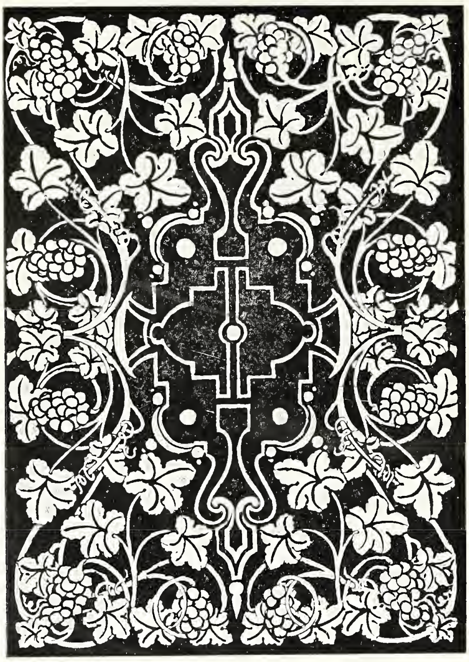
COPPER AND BRASS COAL VASE INLAID WITH ZINC.

FIG. 15.

BRASS AND COPPER FLOWER VASE INLAID WITH ZINC.

is shown in Fig. 18, the metals being zinc and copper, and the size of the plate $4\frac{1}{4}$ inches by $2\frac{3}{4}$ inches. Fig. 19 is a reproduction of a prayer-book cover in copper, the zinc being burnt into certain portions.

Fig. 16.



Copper Panel, 4 inches by 3 inches, inlaid with Zinc.

Fig. 17.

Iron Panel, $3\frac{1}{4}$ inches by 2 inches, inlaid with Zinc.

This new process of burning in and blending metals enables a very beautiful colour effect to be obtained, with great subtlety of colour; the colour effects ranging from silver white zinc to yellow brass and bronzes of various shades, graduating to red copper, and autumnal shades of yellows and golden browns.

A great charm about this new process of inlaying metals, and one that is unique, is that the inlay has not the sharp line of demarcation, as is essential to damascening, but a soft transition from the inlaid metal to the surrounding metal. For instance, in the case of inlaying zinc into copper, it will be observed that the zinc is surrounded by a band or halo of a golden-coloured alloy.

This process of inlaying or damascening is not confined to zinc and copper, but has been

Fig. 18.

Copper inlaid with Zinc.

su ccessfully applied to such metals as nickel cobalt, antimony, and aluminium. Some specimens of these metals, inlaid one with another, will be found on the table.

In conclusion, I venture to express the hope that this new process of inlaying and blending metals in its more advanced state may be the means of reviving in England the beautiful art of damascening, and the inlaying and blending of metals, and bring damascend metal work within the scope of all lovers of the artistic, and that it may become an industry of villages, to which it readily lends itself. The old method of damascening is essentially an Eastern craft, dependant as it is, on skilled cheap and patient labour. The process which

I have described to you to-night is capable of producing inlaid work, both of elaborate and delicate designs in a few hours, yet each piece produced has its own individuality, and

FIG. 19.

COPPER PRAYER-BOOK COVER INLAID WITH ZINC.

truly records the touches of the artist. I should also like, before closing, to thank those who have helped me in the preparation and production of the various specimens which are exhibited to-night.

DISCUSSION.

The CHAIRMAN thought that, in reference to damascening, of which so much had been heard, and which was only one of the subjects touched on by the author, that the audience might be interested to refer to M. Lacroix's article in the *Gazette des Beaux Arts*, giving a history of the art. It was also interesting to note the variations in nomenclature at different times and in different countries. In the sixteenth century the notable damascenist, Paolo—called "Azzimino"— had learned the art, "Al-ajam," from Saracens, who practised it in Venice, and a very fine specimen of this work was described by Lacroix. The French adopted the word "assim-iniste" to describe the craftsman, but still adhered to the word "damasquinarie" to denote the work done. This latter resembled the sixteenth century English word "dam-keen," and both implied the recognition of Damascus as the centre, *par excellence*, of the damascening art. But before the fame of Damascus had been established there were many evidences of fine inlaid metal work by Gallo-Romans in the seventh century, also by the Celts in Scotland and Ireland, and by Scandinavians. Of course the ornamental style of their work was different from that of the Saracens but in principle the process was practically the same. In modern times one might mention Zuloago of Madrid, and Morel-Ladeuil of Paris, and others who had worked for Tiffany of New York, and had exhibited much skill as artists. The late Mr. Alfred Morrison, who was a very generous patron of modern art manufacturers, had some of the finest examples of damaskeening by the artists he had named. He observed that Mr. Cowper-Coles laid some stress upon a particular charm in the results of his invention, arising from the quality of softness in transition from the inlay to the surrounding metal. That softness was, of course, something quite different from the crispness of demarcation seen in the traditional damascening. Each process clearly had its own peculiar effects, and whilst one might perhaps gladly welcome the new process and appreciate the advantages it gave, he did not think it could be accepted wholly as a substitute for the matured form of damascening as inherited from the Saracens.

Mr. C. KRALL said he had had some experience of damascening, and hence he would like to ask why damascening had been described as simply inlaying with wires, or fastening on to the surface by certain engraved lines, which kept the metal in position. The secret of the damascening, which had long been kept, was not only the rough surface produced either by cutting teeth into the metal or doing it with acid, but also doing those things in combination with heat, using that heat at a certain degree to fuse the metal—the gold or silver—on to the steel, and it was done quite as firmly as any process could do it. It appeared to him that by damascening proper the process of inlaying gold and silver wires was generally understood, which is quite erroneous; though what was damascened in the central and northern parts of Europe during the last centuries was principally done in this way. The small arms industry in Belgium have their gold enrichment done by wire inlay, work mostly by men working at home in small rooms in the upper storeys of houses. Line after line is cut into the steel, and where layer surfaces of gold are wished for, these lines are placed very close to each other, so that after inlay and rivetting over the wires into those jaggered, undercut grooves, a plain surface is obtained. of different alloys this surface may appear in hues of By using gold yellow, green, red, or blue, and it may be burnished afterwards into a smooth surface when the trace or effect of single wires is not desirable. Damascening was, however, not done by fixing wires into grooves but by the secret process of fixing their sheets of solid gold on to the steel surface, and where small ornamentation was

often obtained by engravings or chasing and gold surfaces, and to remove bits of gold to form the ground between the ornament. By it large surfaces can be covered with gold plate in a very much shorter time and quite as homogeneous and firm as by wire inlay. His people had done similar work very successfully, and most of the Eastern, Spanish, and Italian work was done in this way. Until very recently in the northern parts of Europe it was almost impossible to find a man capable of doing it, and he knew of very important work intended to be damascened in part where recourse had to be taken to gilding. As a matter of fact, the laying of gold on to steel plate without incrustation of wires was, at least in his opinion, the principle of the art of damascening. He welcomed very much the new method of fusing ground metal at a low heat into prepared surfaces, and had no doubt that being such a cheap process it would be largely and effectively adopted for decorating purposes—but he thought the old style of damascening would always hold its own against the new process.

Mr. Fairfax Mückley said he judged by the remarks of Mr. Krall that there was a feeling of rivalry between the old method and the new; but his own opinion was that each method had its own particular charm, and that one should not be put into comparison with the other. Each process was certainly very beautiful in its way, and Mr. Cowper-Coles' method would stand by itself.

Mr. W. M. Mordey heartily congratulated Mr. Cowper-Coles on the beautiful results he had shown of his very interesting process. The author was to be commended not only for the scientific interest of the process, but also because it seemed to open up a new path for artistic work. He deserved congratulation on the artistic help which he had had in the preparation of the beautiful samples brought to illustrate the paper. The process should prove successful. It enabled broad effects of a highly artistic character to be obtained on ordinary domestic articles. It showed the hand of the artist, and that would differentiate such work from a great deal of the mere mechanically produced and reproduced work, which one saw everywhere. Perhaps justice had scarcely been done to the Spanish damascening. Very little of that iron work came out of Spain now. He had more than once been to the little village of Eiba, in the Basque Pyrennees, where a considerable industry in that class of work was carried on—an interesting survival of the old damascening work on Spanish armour and Spanish blades. The work carried on in that village, and in one or two other small places in Viscaya was beautifully artistic, and was done by the Basque peasants. The process, as carried on there, was primitive but interesting, and therefore he might be allowed to mention a little of what he saw there. The articles were batched, with a sharp knife, into innumerable lines very close together, so that the appearances of the iron resembled that of a cat's tongue. The design was then placed on with gold wire, and pressed in until the little points gripped the wire. It was then worked and burnished in, the points formed by crossings of the knife-cuts closing a little over the wire and holding it in. Some sixteen years ago he bought in Eiba a watch ornamented in that style. He exhibited that watch as a specimen of fine and durable work. Though it had been used continuously ever since, the design was still as good and clear as ever. He had always felt surprise that so little of the work had come into the English market, or, indeed, crossed the Pyrennees at all.

Mr. H. Oppenheimer said he could not contribute in any way to the discussion on damascening, but he felt bound to add a few words of thanks to those uttered by the last speaker, for more than one reason. Until lately the name of Mr. Cowper-Coles was unknown to him, but a week ago he received a letter from the Continent requesting him to find Mr. Cowper-Coles's address. An important firm of manufacturers on the Continent had heard of Mr. Cowper-Coles's invention. That showed how intelligence of inventions travelled abroad, where these things were often more highly appreciated than at home.

The Chairman proposed a hearty vote of thanks to Mr. Cowper-Coles for his very instructive paper, and the very admirable samples and photographic slides with which it was illustrated.

THE GERMAN PERFUME INDUSTRY.

The German perfume industry appears at the present time to be one of the most important and successful in the world, rivalling that of France and England. Some of the largest factories are in Leipzig, but Berlin, Carlsruhe, and Hamburg are important centres of the trade. There has been a vast increase in the last few years in the diversity of essential oils produced from plants, and according to the American Consul at Hanover, forty varieties of those plants are employed in the German factories, which use as well such products as nutmeg, cinnamon, camphor, balsams, pepper, musk, ambergris, &c. The production of the essential oil is expensive, ranging from £45 per pound downward, according to the scarcity of the oil in the plant. With fresh flowers, the distillation takes place as near the place of picking as possible, as the fresher the products the better. The stills contain about 3,300 pounds of flowers and the necessary amount of water. Great care is taken as to the amount of heat supplied, and to its regularity, as, if the process is thoroughly controlled, an excellent product results. In the "fat'

process, the flowers are carefully sorted and the chlorophyll glands broken. They are then stirred gently for some hours, that they may become thoroughly saturated with the slightly warmed fat, with which the flowers have been placed. The fat and flower mixture is then separated in centrifugal machines, so that the fat may be used again with fresh flowers till it is thoroughly saturated with the perfume. Then a layer of cold fat is placed on glass plates and covered with flowers; many of these are stacked together in crates and left for about thirty days, during which the flowers are changed every day. After the thirty days the fat is cut into strings and placed on wire web frames, which are placed alternately with metal sheets covered with flowers in a press where they are subjected to a slight current of air. In this way the utmost amount of perfume element is obtained, but the operations require careful attention, so that there be no trace of a herby scent. The essential oils are packed in round iron containers, which are coated with zinc inside, and very securely closed. For liquids only the best sort of alcohol is used, and never that obtained from potatoes or corn, &c. For the cheaper kinds of scent, the dilution is often made with vinegar and water, as it is cheap, and the scent lasts a long time. Artificial perfumes are made much more easily now than formerly, and can be secured ready for use with a little admixture to add to their durability. Formerly this was an expensive process, necessitating the lixiviated extract from the French fat being mixed with ethereal oils, &c.

CHILEAN COMMERCE AND INDUSTRIES.

Chile occupies an unfavourable position geographically, and is the most isolated and inaccessible from Europe and the United States of all the South American countries, although European countries ship their goods there. It lies between the lofty Andean range of mountains and the Pacific Ocean, and is over 2,000 miles in length, and does no exceed 200 miles in width. Its natural condition and vast resources make it an agricultural and mining country. It contains approximately a population of 3,000,000, more than one-half being engaged in agricultural pursuits. Great quantities of cereals, wine, and vegetables are produced, and horses, cattle, and sheep are bred in large numbers. The mineral wealth of the country consists of gold, silver, copper, manganese, iron, cobalt, lead, coal, nitrate of soda, borax, sulphur, &c. Very little manufacturing is carried on, according to the United States Consul at Valparaiso, the bulk of the manufactured articles used being bought in Europe. Vast tracts of virgin forests are found in the southern part of Chile, the woods being of excellent quality, and consisting chiefly of the cypress, laurel, "lingue," and "rauli." The chief metallic product is copper, of which in 1903 36,600 tons were produced, valued at £1,430,000. The primitive methods employed in mining and reducing the ore greatly lessen the output. With modern machinery and appliances the preparation of the copper for the market could be made more profitable. There were also produced gold valued at £120,000; silver, £85,000; lead, £600; manganese, £45,000; cobalt, £6,600; iodine, £108,000; borax, £160,000; salt, £21,600; sulphur, £22,400; coal, £550,000, and nitrate of soda, £9,340,000. The nitrate product is the greatest source of Government revenue. The exports in 1904 amounted in value to over £11,000,000, chiefly directed to the United Kingdom, Germany, United States, France, Holland, Belgium, Italy, Spain and Portugal. The imports of coal into Chile in 1904 amounted to 822,000 tons, of which the United Kingdom furnished 605,000 tons, Germany 20,900, Australia 179,400, Belgium 1,700, and the United States 15,000 tons. The principal agricultural products are wheat and barley. Usually these are exported in considerable quantities; but as a result of a shortage in production, flour was imported into Chile from the United States during the year 1905. There is very little maize grown, and corn meal is little used. The crop of brewing barley and hay was of an inferior quality. In 1904 barley, wheat-flour, potatoes, hay, seeds, wheat, and wine were exported. The total imports for the year 1904 amounted to £11,950,000, as compared with £10,685,000 in 1903. The exports in 1904 were valued at £16,250,000, as compared with £14,704,000 in the preceding year. The principal articles imported into Chile from the United Kingdom are coal, woollen and cotton manufactures, animals, hardware, iron, machinery and sugar; while the chief articles received here from Chile comprise nitrate of soda, copper in bars or ingots, grain, iodine and ores. With a view of exploiting and developing the vast mineral resources of the country the Chilean Government is manifesting considerable interest in providing better means of transporting the products of the country to market. The intention is to build new railways, and to extend those already in operation. The Transandine Railway, when completed, will shorten the time between Chile and Europe ten or twelve days. At present there are several new railways being constructed or extended. The building of a railway through Chile for a distance of 1,500 miles is being seriously discussed, and is said to be beginning to assume tangible form, 300 miles of the road having already been surveyed. Chile has but two electric car lines—one at Santiago, the capital, and the other at Valparaiso—both of German installation. The Government has granted several concessions for the construction of inter-urban lines, all to be built this year. A new line will be constructed from Conception to Talcahuano by Americans, the entire equipment to be sent from the United States.

HOME INDUSTRIES.

Electricity in Spinning Mills. — Attention has been directed more than once in these notes to the growing tendency of Lancashire mill owners to use electricity for driving their spinning mills, and its great superiority over steam is now generally allowed. The electric motor has been proved to transcend steam on the score of reliability, efficiency, steadiness, regularity, and small working cost. Horse-power for horse-power, the efficiency of driving in a mill is 36 spindles of electricity as against 33 for steam. In the system of transmission of power there is a gain of 9 per cent. in favour of electric driving, and the extra output due to electricity is equal to $7\frac{1}{2}$ per cent. In the matter of steadiness and regularity of drive, so essential in the production of yarn, as the value of the finished product is impaired by irregularity, recent tests have shown that on a frame driven by a steam-engine and belting, with special attention given to ensure the best results, the revolutions per minute of the front roller varied between 118 and 113, whereas the speed was supposed to be 122. On a similar machine driven electrically by motor, the average speed of 71 readings was 121·35. Under these circumstances it is not surprising that manufacturers and spinners are now bestirring themselves to replace the less trustworthy or efficient driving force by its more modern rival.

The Trade in Cameras.—The home trade with India in cameras should grow rapidly, seeing that in India they are used for all sorts of purposes. For example, the camera is largely used in the military and civil services, by the professional classes, in the work of education, and as a means of relaxation by the white and native populations. To the civil engineer it is invaluable, as by its means he may be kept informed daily of the progress of work many hundreds of miles distant. On the other hand, no more trustworthy evidence of the behaviour of a bridge under a loaded train can be furnished than that supplied by the camera. Similarly the effects of water erosion in given localities may be clearly followed, or the dangers of a landslide in mountainous districts infallibly detected by a series of periodical photographs, taken from a given point and in a given direction. Equally useful services are performed by it in recording the effects of earthquakes on buildings, for by this means much may be learnt as to what to avoid in building in localities where earthquake shocks are frequent. In the search for water, too, so necessary in the more arid districts of India, the camera may be employed with advantage by the inexpert, with a view to subsequently obtaining technical advice as to the suitability or otherwise of the spot for the proposed well sinking. To the architect and engineer the recording of the beautiful details of architecture which he frequently comes across may be found of great use at some future period in designing a building. This is one aspect only of the utility of the camera, but it has almost an equally wide scope in the medical profession, in the curriculum of the colleges, and other departments. Little need be said of its recommendations to the professional photographer, or to those who use it as a pastime. As the uses to which the camera may be put are divers, so are the kinds of camera for which India makes demand. But all types of camera need to be made of materials impervious to the effects of the great heats and moistures peculiar to the climate. Woods of superior density and toughness, such as teak and mahogany, should alone be used in their construction, properly dovetailed, and the various parts usually fastened or cemented together by glue, additionally secured by metal clamps, to resist the separating tendency resulting from the decomposition of the glue. Simplicity of mechanism and construction, conducing to ease of repairs, is also a consideration when cameras are used at remote places where skilled labour cannot be counted upon.

Marine Motors.—According to recent Consular and other reports, there is a growing demand in China for motor boats, their superiority for the requirements of the country being recognised. More of them are likely to be placed in the course of the year for service on the Liao River, at Harbin, Port Arthur, Dalny, and Newchang, and on other waterways gradually, as the success of these first attempts is generally observed. At Newchang the current on the river ranges from 3·4 to 7·8 nautical miles per hour in swiftness, according to the season and the state of the tide, and boats can be easily equipped with engine-power sufficient to render them useful in the traffic of that port. The foreign mercantile population will at the beginning be the principal purchasers, for business or pleasure, and next the Japanese, while there will be probably a large call ultimately among the native population for motors for the conversion of sail and row-boats into power-boats. The Liao is, it is to be observed, closed by ice from about November to March, so that this year intending clients will be placing their orders with manufacturers within the next five months.

Marine Mo'ors for Export.—Opinions of engineers differ widely as to the lines of construction, and as to the suitable marine motor to be installed in launches and small boats, and the intending purchaser must take his choice among the systems offering, all of them of more or less parity of merit. There is one point, however, on which the purchaser can exercise his discretion, and that is in the choice of the fuel which he elects to use. This is, in many localities, a prime consideration, for all classes of fuel are not equally abundant everywhere. Heavy oils being perhaps the commonest item of export, and found everywhere, have the advantage of cheapness and convenience, the disadvantage of pungency of smell, which militates against its use. Lighter oils and the several oil spirits, while exempt from these

drawbacks, are relatively becoming increasingly costly. It is for the prospective user to balance these two factors before making his choice. Besides oil, however, the buyer has the choice of coal-gas and alcohol. The new departure in the construction of compact plants for the production of producer gas renders it possible for a launch to be fitted with a plant which generates the gas from the cheapest class of local coal obtainable for its own use, and at the time of use. Simple in mechanism and working, a plant of this kind presents advantages which many will appreciate. There remains finally the alcohol engine, which, similarly to the producer gas plant, may be equipped with a small complementary plant to enable it to generate its own requirements of alcohol, distilled from local waste products, such as damaged rice, rotten potatoes, wood, &c. For this class of engine and plant there is a great future, and the last word of invention has not yet been said on the subject.

The Cornish Tin Mines.—Reference was made here last week to what promises to be a considerable revival of Cornish mining. If Cornish tin mines cannot be made to pay, or it is not profitable to re-open closed-down tin mines when tin is in the neighbourhood of £200 per ton, the industry is scarcely likely to be revived. One of the chief difficulties in the way of a revival in Cornwall is the system under which the Cornish mines are worked. The "cost book" system, as it is called, has hindered, and continues to hinder, the development of the Cornish mining industry. Suited to the conditions obtaining at its inception, and for a long subsequent period, it is quite unsuited to the conditions of present day mining, and it is encouraging to learn that there is a tendency to abandon it for the limited liability principle. Nor again does the system of royalties current in Cornwall foster mining enterprise. The usual terms are a nominal rent and a royalty upon the produce of the mine. Moreover the landowner has the power to interfere in the management which may well lead to complications. Some Cornish mines pay a royalty on output, others on profits. Public opinion in the Duchy favours the latter system, assuming of course the proportion of the profits demanded by the landlord to be a fair one. In their own interests, if for no other reason, the Cornish landlords may be expected to come more into line with business arrangements in other countries. The success of tin mining in Cornwall, as elsewhere, must largely depend upon the market price of the metal, but there is every reason to believe, as explained in the *Journal* last week, that for a long time to come prices will leave sufficient margin for profit even in Cornwall, always assuming up-to-date methods of production.

Victoria Falls and Electric Transmission.—It will be remembered that some months ago the *Journal* referred, at some length, to a scheme for electrical transmission from the Victoria Falls, which gave rise to rather heated difference of opinion between the experts consulted. The scheme has not been proceeded with, but if the *Transvaal Leader* is well informed it is to be revived in a somewhat modified form. The new proposal appears to be to construct an installation at the Falls of a potential of 20,000 horse-power, which is to be conveyed to the Rand, and sold at a price estimated at 0·9d. a unit. But, in addition, it is proposed to erect a steam reserve station with a further capacity of 20,000 horse-power, in the neighbourhood of Johannesburg. The steam reserve station is to be utilised in a supplementary capacity only, and as an insurance against breakdowns on the transmission line. The *Transvaal Leader* says that the promoters of the scheme have the opinion of many experts as to its practicability. These experts are also satisfied that "there should be no fear of any breakdown of supply for more than a few hours, and that if such breakdowns occur, they would not cause any inconvenience to consumers, as the reserve coal power station would be able to supply the requisite additional power until the necessary repairs were effected." It remains to be seen whether the experts, or any of them, will disavow, or differ as they did when the earlier scheme became the subject of public discussion.

Constructional Iron in India.—The use of corrugated iron in India is very general, and the consumption grows apace, the over-sea imports alone totalling over £6,000,000, of which great trade the United Kingdom enjoys 65 per cent.; Belgium, Germany, and the United States being after her the greatest competitors. Corrugated iron is used in India as a covering of the native's booth in the bazaar, and as the roof of the tea-planter's factory, the weaving and spinning mill, the railway station, and the wharf shed. In conjunction with ornamental accessories of pilasters, pillars, and verandahs, it becomes the civilian's seaside, city, or up-station bungalow, the official Residency, or the collector or magistrate's offices. Its vogue, as also that of constructional iron, is due to the exigencies of the climate, the ravages of insects, and other contributory causes, not least of which are the earthquake disturbances. There can be little doubt that recent earthquake visitations in India will serve as a great incentive to iron frame building constructions, whilst as regards lightning, it is beginning to be generally recognised that the iron building properly constructed is the most secure haven during the prevalence of tropical thunder storms, the iron roof serving to collect the dangerous fluid, and the iron pillars and other upright supports acting as safe conducts of it to the earth. It is not surprising, therefore, that there is an ever increasing demand not only for the elemental items of construction, but also for the wholly fabricated article, portable, transportable, and easily erected, as well as for specialties such as wire-wove roofing, armoured concrete, &c.

CORRESPONDENCE.

DEVELOPMENT OF WATERMARKING.

I have read with much interest Mr. J. Melrose Arnot's letter appearing in May 25th issue of the Society of Arts *Journal.* I confess that by adhering too rigidly to the definition which I laid down for watermarking, I omitted processes which might be considered to come under that category.

In addition to those referred to by Mr. Arnot and the Secretary, we have that invented by Schlumberger, which he terms "Safety Kryptography," in which certain figures or letters which are hidden in the back ground of the paper are invisible until moistened with the smallest quantity of water or some special re-agent, when they appear in bright colour.

In conjunction with Messrs. C. F. Cross and E. J. Bevan, I worked for some years on this subject by processes of electro deposition, in which we were able to impart to paper invisible designs capable of after development by re-agents, and in some cases capable of being rendered invisible again. These did not appear to commend themselves to the banks as a safeguard, as there were practical difficulties in the way of their application.

In the course of such work I discovered a means of watermarking paper electrolitically When a current is passed through moistened paper, the paper in contact with the anode becomes water-repellent, producing a visible mark. The mark disappeared on drying the paper, but re-appeared when the paper was re-wetted. I applied for a U.S.A. patent, but an interference was declared by the examiners at Washington, due to the fact that a patentee had patented a process for rendering paper or cloth uniformly water-repellent all over its surface, by passing the same through rollers through which a current of electricity was passed. This method of producing a watermark by "polarising" the cellulose might be regarded as a true watermark, although only visible when the paper was wetted. In the course of time depolarisation appeared to take place so that re-wetting no longer took effect. When certain metals were deposited in cellulose in such a way as to be invisible until developed by certain re-agents, the activity of these deposits deminished in the course of a month or two. Thus, in the case of the deposition of iron, which can be easily rendered invisible by the application of dilute tannic acid, its power of re-acting ceased in the course of a few months. I did not refer to such processes as these in my paper, because, in the first place, they did not come within the category of my definition, and secondly, they so far, have not given practical results.

CLAYTON BEADLE.

Laboratories, 15, Boro', S.E.
May 3 th, 1906.

GENERAL NOTES.

SWEDISH EXPORTS.—It is a little strange that, whilst the exports of butter and cheese from Denmark are rapidly increasing, the exports of these articles from Denmark's nearest neighbour, Sweden, are rapidly diminishing. The amount of cheese exported from Sweden, as shown by Mr. Consul McGregor in his report on the trade for Sweden, 1905 (3560, Annual Series), has now become quite insignificant, while the diminution in the exports of butter is considerable. The exports, which in 1903 were 20,030 tons, fell in 1905 to 18,400. Yet the south of Sweden is admirably suited to dairy farming. If, however, the exports of butter and cheese from Sweden to England diminish, those of paper steadily increase. In 1903, 472,116 cwts. of printing paper in rolls, and 742,161 cwts. of printing paper not in rolls, were exported to England; whilst in 1905 the exports of paper in rolls had increased to 558,996 cwts., and the paper not in rolls to 842,452 cwts.

MEETINGS FOR THE ENSUING WEEK.

TUESDAY, JUNE 5...Royal Institution, Albemarle-street, W., 5 p.m. Colonel V. Balck, "Northern Winter Sports." (Lecture II.) "Sweden and its People."

WEDNESDAY, JUNE 6...Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. W. P. D. Stebbing, 1. "Notes on the Early History of the Parish Church of Worth, in Sussex." 2. "Notes on the Architecture of Denham Church, Bucks."

THURSDAY, JUNE 7...Linnean, Burlington-house, W., 8 p.m. 1. Mr. H. H. Haines, "Two New Species of *Populus* from Darjeeling." 2. Mr. W. E. Hoyle, "Biscayan Plankton." (Part VIII.) "The Cephalopoda." 3. Mr. E. T. Browne, "Biscayan Plankton." (Part IX.) "The Medusæ."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. A. E. H. Tutton, "Ammonium Selenate and the Question of Isodimorphism in the Alkali Series." 2. Mr. J. M. Sanders, "An Improved Beckman Apparatus for Molecular Weight Determination." 3. Mr. J. C. Irvine, "Resolution of Lactic Acid by Morphine." 4. Mr. A. Marshall, "The Vapour Pressures of Binary Mixtures." (Part I.) "The possible Types of Vapour Pressure Curves." 3. Mr. I. Smedley, "Action of Sodium on *aa*-dichlor-propylene." 6. Mr. J. Moir, "Thiocarbamide as a Solvent for Gold." 7. Messrs. S. Smiles and R. Le Rossignol, "The Action of Sulphur Dioxide and Aluminium Chloride on Aromatic Compounds."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. J. Sollas, "Man and the Glacial Period." (Lecture III.)

FRIDAY, JUNE 8...Royal Institution, Albemarle-street, W., 9 p.m. Prof. Sir James Dewar, "Studies on Charcoal and Liquid Air."

Astronomical, Burlington-house, 5 p.m.

Geologists' Association, University College, W.C., 8 p.m. Messrs. H. J. Osborne White, and Ll. Treacher, "The Higher Zones of the Upper Chalk in the Western Part of the London Basis."

Physical, Royal College of Science, South Kensington, S.W., 8 p.m.

SATURDAY, JUNE 9...Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. Macneile Dixon, "Inspiration in Poetry."

Journal of the Society of Arts.

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FRIDAY, JUNE 8, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The central portion of the gardens only will be used. The gardens will be illuminated with coloured lamps, and also by the Kitson incandescent oil light. The Conservatory and the Club-house will be open.

The reception, by Sir Owen Roberts, M.A., D.C.L., F.S.A., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

The Tropical-house, containing the giant water lily (Victoria Regia), and other interesting tropical plants, will be open to visitors.

An exhibition of growing and cut roses and other flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

A selection of music will be performed by the string band of the Royal Artillery in the Conservatory, and by the band of H.M. Scots Guards in the gardens, commencing at 9 o'clock.

Two performances of selections from pastoral plays will be given in the gardens by Mr. Patrick Kirwan's Idyllic Players at 9.30 and 10.30 p.m.

A concert and entertainment by members of Mr. Kirwan's company of Idyllic Players, with choruses by children (Bellew and Stock's choir), will be given in the Club-house at 9.45 and 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, May 24; The RIGHT HON. LORD CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., Vice-President of the Society, in the chair.

The CHAIRMAN said that Major Sykes did not need any introduction to the meeting. It was now thirteen years since he first travelled in Persia, and began to devote his abilities, energies, and public work to that country and to British interests there. He was the first British Consul at Kerman, the place about which he would, in the main, speak that afternoon. A little later it was his (Lord Curzon's) privilege to send Major Sykes to open up another British Consulate in a more remote, but not less interesting part, namely, Seistan: and only last year, when the Consulate-General at Meshed, the capital of Khorasán, fell vacant, he had no hesitation in selecting Major Sykes as the most competent

British representative for that important post. During that time Major Sykes had acquired quite unusual influence and a very uncommon popularity with the Persian people, high and low, from the prince to the peasant; and there was no living Englishman with a greater knowledge of Persia or a greater influence with Persians than the reader of the paper. He had also devoted the greater part of his leisure hours to writing about Persia, from a very substantial book down to—or up to—papers before that Society, which would supply any one with a compendium of all about Persia which was worth knowing. And, finally, he was about to add to those services by a paper relating to that most interesting, and hitherto unhappy community, the Parsis of Persia.

The paper read was—

THE PARSIS OF PERSIA.

By Major P. Molesworth Sykes, C.M.G.

H.B.M.'s Consul-General and Agent to the Government of India, in Khorasán.

On the previous occasion on which I had the honour to read a paper before the Society of Arts, my subject was South-east Persia, with special reference to the journeys of Alexander the Great and Marco Polo. This afternoon, I invite you to return to the same remote part of Asia where, at Yezd, and at and around Kerman, some ten thousand Persians still cling to the ancient faith, as taught by Zarathushtra or Zoroaster.

Antiquity appeals strongly to mankind, and my present theme deals with the followers of a religion so hoary that the worshippers of Baal, Osiris, and Zeus may all be mentioned as its contemporaries. I thus hope that I may secure your interest, when I ask you to accompany me back to the dawn of history, to a period at which the clouds of myth had not yet rolled away, and so down the ages to the twentieth century, until I show you a virile remnant of adherents to this venerable faith, which remnant is now setting its footsteps on the stony tracks of progress. Indeed, by its tough endurance alone, it earns a right to the sympathy of Englishmen, who also know that the Parsis of India are in the vanguard in all that makes for progress and civilisation among the ancient peoples and nations with whose destinies that of our imperial race is so closely interwoven.

Before, however, proceeding any farther, it may not be out of place to give the meaning of the word, Pársi, which I shall have occasion to use so frequently. *Pársa*, the Persis of the Greeks, now known as Fárs—the Arabs could not pronounce the letter P—is one province out of several which, from ancient times, composed the Persian Empire; but, because that province gave birth to the mighty Achaemenian dynasty which, as mentioned below, carried its arms to distant Greece, its meaning was extended to include the whole nation, just as the Angles have given their name to England.*

To-day, the term Fársi, if applied to a man, signifies an inhabitant of Fárs, and if to a tongue, it means the Persian language. Finally, Pársi is the term used in India to denote the refugees from Párs, *i.e.*, the Zoroastrians who, in Persia, are usually called Gabr; this term now signifies an infidel, but originally it meant a man as, for instance, Gabriel, "the man of God." Gabr appears in English literature as Giaour, and in Moore's poems, as Ghebre.

I now propose, by way of preface, to make a brief survey of the ancient history of Persia: and here I would remark that, in dealing with this subject, it is somewhat difficult to know precisely where Persian history commences.

Until comparatively recently we knew of nothing more ancient than the Achaemenian dynasty referred to above, but, thanks to the success of the French mission at Susa, the history of Elám, the Arabistan of to-day, has been rescued from oblivion, and we read of an Empire which had existed for more than 3,000 years before being crushed by a rival State. It was in B.C. 645 that Assurbanipal, King of Assyria, razed Susa to the ground, and overthrew an Empire which had played a great part on the stage of Asia, and had fought on equal terms with both Chaldea and Assyria.

After this brief introduction to the earliest history of Irán, we must quit the valley of the Kárun and turn our attention to what is now known as the Irán plateau.

In treating of the lowlands of Elám, we have to do with a Semitic race connected with Chaldea, but in the highlands of Persia we are transported into a land peopled by Aryans, who have given its nomenclature to Irán. I do not propose to raise the vexed question of the origin of the Aryan people—a question with which I am not competent to deal—but we may believe that in dim, prehistoric times,

* I would hasten to acknowledge my indebtedness to Professor Browne's "Literary History of Persia," to M. Ragozin's "Media," and to Professor Jackson's "Zoroaster."

Indians and Persians were once united in a common Indo-Iránian stock.

In the first place, I invite your attention to the section of Asia which to-day includes the Persian province of Khorasán, my present home, and also Northern Afghanistan and Trans-Caspia. All of these provinces as far as the River Oxus were then Khorasán, or the Land of the Sun, *i.e.*, the East, and they formed a kingdom which was co-existent with later Elám and Chaldea, and also with Media.

Firdausi's "Sháh Náma," one of the greatest epics which enrich the literature of the world, testifies to this with much emphasis and detail and, as the Avesta—the Parsi scriptures—and other authorities unite in corroborating what Firdausi wrote, it is safe to accept the facts which form the substratum of the epic. In it the dawn of civilisation is exemplified by the struggles between monarchs and savages, who are referred to as *Divs*. This word is a particularly interesting one and deserves our attention. In old Aryan *Div*. signified a "bright heavenly being" and as such has descended to us in the form of "Deity." The Zoroastrian reformers, however, in order to throw odium on the nature worship, termed these old-time gods *Divs* or fiends. *En revanche*, Ahura the Supreme God appears as a fiend under the form of Asura in the later hymns of the Rig-Veda of the Hindus, whereas, in the earliest, he is the God of Gods. Many of the monarchs and heroes of this prehistoric era are indeed the forces of nature, which were first deified and then brought down to earth. Greatest among these shadowy characters was Jamshid, who introduced the solar year and the *No Ruz* or New Year's *fête*, which has ever since been observed at the vernal equinox as the greatest feast in Persia. He was conquered by Zohak, who is Aji-Dahak, the primeval serpent presented in human form. In short, all that is written about this Peshdadian dynasty, as it was termed, is vague and legendary, but we come to firmer ground when the Keianian dynasty ascends the throne of Persia. Thenceforward for some centuries the main theme is the immemorial conflict between Irán and Turán, the country east of the Oxus, struggles of which the mediæval counterpart was the devastation wrought by Chengiz and Tamerlane. One striking episode of these campaigns is well known to us from Matthew Arnold's "Sohrab and Rustam," an episode which is, as Firdausi writes, "full of the waters of the eye."

In the time at my disposal, it is out of the question to deal even briefly with the mighty warrior kings whose names we know, thanks mainly to Firdausi, and we pass on to the period when Gushtásp, undoubtedly an historical personage, sits on the throne. He it was who became the first royal convert of Zoroaster, and, thanks to his conversion, the religion he taught ultimately became the national religion of Irán. Gushtásp reigned in the seventh century B.C., and, in propagating the new religion, waged numerous campaigns, more especially against the hosts of Turán.

We must now temporarily quit this interesting figure and also Khorasán for Western Persia and the provinces now known as Irak and Azerbáijan, but, at that period, termed Media. It was in Media that, anterior to the rise of the Persian Empire in its widest sense, a kingdom was formed by its hardy inhabitants, who, like the people of Khorasán, were Aryans, and spoke a tongue akin to Old Persian. This fact will explain why, in the pages of Holy Writ and elsewhere, the Medes and Persians are frequently referred to as one people. Bearing this in mind, we turn to the Assyrian records and find that the earliest reference to Media and the Medic capital of Amadana—the classic Ecbatana, and the modern city of Hamadán—is made by Tiglath Pileser (B.C. 1100), who mentions it as a subject state. Again, Salmonassar—Sargon (B.C. 731-713) boasts that, even in distant Media, his name is feared, and apparently, with truth, as we read in II. Kings xvii. 6, that "in the ninth year of Hoshea (*sc.* B.C. 722), the king of Assyria took Samaria, and carried Israel away into Assyria, and placed them in Halah and in Habor, by the river of Gozan, and in the cities of the Medes." In B.C. 713, King Sargon subdued Media, which is here referred to by the name of its prince as the "Land of Deioces";[*] but, a few years later, Media was successful in throwing off the Assyrian yoke. In B.C. 647, an independent king of Media, Phraortes, extended his rule over the inhabitants of Fárs and, in B.C. 607, the Medes, in alliance with the Babylonian king, captured Nineveh, the fall of which city is one of the great dates of the world which every schoolboy should be taught.

The next province of Irán to which we must turn is that of Anshán, which is now known

[*] I have made no attempt to connect the kings of Media with those of Khorasán.

as the Bakhtiári country, and consists of a series of ranges with the North-west trend almost universal in Persia, lying between ancient Elám and modern Isfahán. This region, so long as Elám was an Empire, formed one of its districts; but, after its fall, it was occupied by the head of the royal family of Fárs, known to us as the Achaemenian. Upon his death, one son reigned in Fárs and another in Anshán and, while the short-lived Median Empire remained a great power, both countries were undoubtedly its vassal states. This double line continued for some generations, until Anshán produced a conqueror who was destined to extend his sway from the river Oxus to the Mediterranean Sea.

It is thus that Cyrus the Great makes his majestic entrance on to the world's stage as Prince of Anshán, and his exploits, thanks in part to Holy Writ, but still more, as the founder of the Persian Empire, naturally excite our keenest interest. To return to the tablets*, we learn that, in 549 B.C., Cyrus warred against Ishtuvegu (the classical Astyages) King of Media whom, thanks to a revolt of his subjects, he captured, Ecbatana subsequently falling into his hands. After this initial and dazzling success, Cyrus, during the next few years, not only consolidated his hold on the wide empire of the Medes, but he also defeated and captured the famous Crœsus, King of Lydia. However, there is no time to dwell on these remarkable campaigns, and we must pass on to 538 B.C., when we find that, after the reduction of Akkad, to the north, Babylon was captured without offering any resistance. Hence we must reject as mythical the famous account given by Herodotus of the diversion of the Euphrates. To the same category we must regretfully relegate that splendidly dramatic account of the feast of Belshazzar and the writing on the wall, which appear in the Book of Daniel, a work written, it is generally believed, in the second century B.C., and thus possessing but little historical value. At the same time, we may well believe that the Jews aided in the priestly conspiracy by which Babylon was surrendered. This, at any rate, appears probable, by the references to the Great Conqueror in the Book of Isaiah, part of which, according to the views usually held, was written by the great prophet himself, the remainder being the work of a writer of a subsequent period. A second and stronger proof is afforded by the extraordinary generosity with which the Jews were treated in being sent back to Palestine with assistance of every kind, as detailed in the books of Ezra and Nehemiah.

* *Vide* "Authority and Archæology," p. 122, *et seq.*

Cyrus the Great was succeeded by his son Cambyses, during whose absence in Egypt a Magian, Gaumâta by name, seized the throne, in consequence of which Cambyses committed suicide. Darius, a member of the royal house, slew the impostor, and ultimately ruled the Empire of Persia in peace. It is to Darius that we owe the foundation of the grandiose series of palaces known to us as Persepolis, some of which will be shown on the screen; and it is the same monarch who engraved inscriptions on the rocks of Behistun or Bisitun, near Hamadán, which, when deciphered, caused a thrill of wonder to run through the West. Thenceforward Persia remained the leading monarchy of the world, until decay set in, which permitted Alexander the Great to avenge to the full the invasion of Greece by Xerxes, son of Darius, which we all read about at school.

We have now reached a point at which it is necessary to inquire who was the founder of the ancient religion of the Persians, and what did he teach. Conflicting opinions have been held, but it is believed that Zarathushtra or Zoroaster, to give him the title by which we know him, was a Magian of Media, who flourished in the seventh century before Christ, shortly before the rise of Cyrus the Great. Further, it is accepted that there is truth in the universally believed legend that Zoroaster's first royal convert was Gushtásp, who has been referred to above, and that it was from Khorasán that the new religion spread throughout Persia.

In this connection, I have recently come across a remarkable legend, mentioned in the "Sháh Náma," which relates to Turshiz, a district to the south-west of Meshed, and formerly the capital of the province of Kuhistán, where, as will be seen below, the Zoroastrians took refuge after the triumph of Islam. The capital, in very ancient times, was termed Kishmar, and it is stated that it was founded by Gushtásp, in honour of the fact that it was there that he first met Zoroaster, who himself planted a cypress to commemorate the meeting. This tree was deemed sacred by the followers of the ancient religion; but, in A. H. 232, or A.D. 846, the Caliph Mutavakkil ordered it to be cut down. It is stated that large sums were offered by the Parsis, but in vain; and the immense trunk was felled

and painfully transported to Baghdad, where, the day it reached its destination, Mutavakkil was slain by his own bodyguard. The interesting point of this story is that the tree was reported to have been 1,450 years old. In other words, it was planted in B.C. 604.* In addition to this, there is the almost universal testimony of Persian and Arabic writers that Zoroaster flourished some three centuries before Alexander. Finally, Professor Williams Jackson, of Columbia University, relying on tradition and co-ordinated evidence, fixes the birth of Zoroaster at B.C. 660, and his death at B.C. 583, and the above dates may, I think, be accepted as accurate enough for all practical purposes.

Before passing to the question of Zoroastrian beliefs, it is not unprofitable to refer to the legends of this Aryan people, to whom the great reformer belonged. Their life, being a natural one, the heavens, fire, the winds, and the life-giving rain storm, were all worshipped, whereas darkness and drought were accursed. To the heavens in this polytheistic system preeminence was granted, and the sun is termed heaven's eye and the stars heaven's robe, the language being similar to that employed by the Jewish prophets.

It may be urged that most religions contain these myths, which are indeed widespread; but with the Aryans there was not, as is also common if not usual, the propitiation of the evil spirits. Rather, they had to be faced and overcome by the good spirits, who, in their turn, depended largely for success on the prayers and sacrifices of man. It is thus evident that the position of man is one of assured dignity. Indeed, the position of man in Persia must be higher than in India, where not only is the climate enervating, and consequently conducive to physical degeneration, but man, owing to the rich soil, the abundant water, and the warmth, literally swarms. In Irán, on the contrary, he is for ever fighting against inclement sterility in a fine, bracing climate. This same sterility also prevents all crowding, with the result that villages are generally twenty miles or more apart. Now, these conditions all make for hardness and virility.

A good example of environment affecting religion is afforded by examining the term "fire-worshippers" so frequently applied to the Zoroastrians. At Baku, and at other places in ancient Media, there are inexhaustible wells of naphtha. I have a vivid recollection of visiting a spot termed Sela Khana, near Baku, where I arrived at sunset, and found flames springing up out of the snow-covered ground. These flames were fed by naphtha gas, and burst up wherever a shallow hole was dug, the result being weird beyond description. Close by was a little courtyard decorated with Hindi inscriptions, where an Indian fakir had, until murdered, tended the Eternal Fire.*

Enough has been said to prove that the institution of sacred fires was absolutely suggested by the environment; indeed, the very name of Azerbaijan—a portion of Media and a province of modern Persia—signifies "the Land of Fire," and, although Zoroaster did not worship this purest of elements, he held, and with truth, that there was no more befitting symbol of the deity.

To resume, Zoroastrian literature is voluminous, and is said to have consisted of 21 books written on 12,000 ox-hides; but the oldest portion of the Avesta is undoubtedly represented by the Gathas, which have been aptly compared to the Psalms of David. In these the prophet stands out as a living being, and one who taught pure, noble, and moral lessons, which excite profound reverence when we remember how dense was the darkness all around. Sometimes pathos is the dominant note, as the following extract shows:—"To what land shall I turn? Whither shall I go? I implore thee weeping, O! Ahura, who grantest happiness as a friend gives a present to his friend."

The Avesta of ancient Persia and the Vedas of the Hindus have many points in common both in the actual names of their gods and their myths. For instance, Jamshid, the reputed builder of Persepolis, who has been already referred to, and who appears in Fitzgerald's

"They say the Lion and the Lizard keep
The Courts where Jamshyd gloried and drank deep,"

is the Yima of the Avesta and the Yama of the Hindu books. He is the King of the Dead, and is depicted as the owner of two dogs, "brown, broad-nosed, and four-eyed," who scent out those who are about to die and conduct them to his presence. The Avesta prescribes that a yellow dog with four brown eyes, or a white dog with brown ears, shall be brought to the side of every deceased person, as its gaze drives away the impure demon who always strives to enter corpses. This

* *Vide* "The Dabistan."

* Vide my "Ten Thousand Miles in Persia," p. 5.

custom still obtains, and I was informed that a morsel of bread is placed on the corpse of the Kerman Parsi. If the dog eats it life has fled. Dogs, I would incidentally remark, were held in greater esteem by Zoroastrians than even in England of to-day, more especially a house dog and a shepherd's dog. The Parsis of Kerman, however, have adopted the Mohammedan idea that dogs are unclean, and were much astonished when I told them that they were thereby sinning against the direct law and also the spirit of their religion.

To return from this digression, the two ancient religions of India and Persia were undoubtedly one; but that of Irán underwent a complete change in the direction of monotheism, whereas the Hindus are still polytheists in the fullest sense of the word. The change may be defined as the attribution of a moral character to all the powers of nature which were active in a mythical character, as mentioned above. This was succeeded by the classification of these powers into good and evil, with the hope and even the assumption that good will ultimately triumph, just as daylight conquers night and the thunderstorm chases away drought. Compare this with the ancient polytheism of the Jews, which was moulded by generations of prophets and tempered by the Captivity into a religion which first assumed the form of a tribal God, and ultimately produced the conception of a God in the broadest sense of the word, *i.e.*, a God of all nations. Here I would add that, as man is a free agent so he is responsible for his acts and, upon those acts, will depend whether, after death, he will cross the bridge Chinvat to heaven or fall and be dragged down to the Zoroastrian hell, the "Abode of Lie," as it is termed.

The Zoroastrian faith, after the death of its founder, was clouded over by a revival of those Aryan myths referred to above, which is the fate of almost all religions at any rate for a time. Some, however, of the doctrines have remained untouched, and to-day what the Parsi is taught, more especially when invested with the triple *kushti*, is "good thoughts, good words, and good deeds," and this is the essence of his faith.

I would now refer to the priceless message which has come down the whispering galleries of time to this twentieth century in which we live. To put the matter briefly, Zoroaster gave the world hope, inasmuch as his religion was the first in which a resurrection was preached. There is no reference in Holy Writ to the resurrection before the Captivity and, even after that epoch, the priestly and aristocratic families, represented by the Sadducees, held that there was nothing in the Scriptures to warrant it. The Pharisees, on the other hand, adopted it, and it is reasonable to assume that they did so as the result of their intercourse with the followers of Zoroaster, "in the cities of the Medes" and "by the waters of Babylon." To conclude this section of my paper, the origin of this belief which, developed and perfected, is a fundamental doctrine of Christianity, may be justly connected with the great prophet who, in the wilds of Irán seven centuries before the coming of Our Lord, preached that there was a God of Gods.*

It is now time for us to take up the history of Zoroastrian Persia at the point where, in the fourth century, B.C. Alexander the Great annihilated the Achaemenian dynasty. For five centuries after this blow, Irán was ruled by the Parthians, who were of Turanian extraction, and were considered to be barbarous and unworthy of notice. Indeed the name of *Muluk-i-Tawaif* or "Chiefs of Tribes" by which these puissant monarchs, who inflicted heavy defeats on the Roman Empire, are known, proves that, so far as Irán was concerned, they were never accepted as constituting a national dynasty.

In the third century after Christ an Iranian dynasty again rose to supreme power in the house of Sásán, founded by Ardeshir, who, among other claims to fame, built the fort at Kerman, which will shortly be shown on the screen. This truly great man collected all the laws and traditions of Zoroastrianism which remained the national religion for nearly four centuries, during which the house of Sásán waned, until, at Nahávand, in A.D. 641, the Arabs, irresistible by reason of their faith in their new religion, subjugated Persia and imposed Islam on its inhabitants.

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* This question is dealt with at length by Stave in his "Über den Einflus des Parsismus auf das Judentum." *Cf.* also Herodotus III. 62, which runs:—

Εἰ μέν νυν οἱ τεθνεῶτες ἀνεστέασι προσδέκεό τοι καὶ Ἀστυαγέα τὸν Μῆδον ἐπαναστήσεσθαι. (Hdt. III 62.)

The idea of the passage seems to be as follows:—Cambyses is accusing Prexaspes of not having put the usurper Smerdis to death according to his commands. Prexaspes replies that, so far from not having done so, he has safely buried him, and that, if Smerdis is going to rise again, Cambyses might as well expect Astyages, the Mede, to rise again and revolt against him—one is about as likely as the other. But if things are to go on as they always have done (εἰ δ' ὥσπερ πρὸ τοῦ), he need fear nothing from that quarter.

I have referred to many books with a view to ascertaining for how long the Parsis resisted the acceptance of their conquerors' religion; but I have found little to the point and have been obliged to form my opinion from incidental remarks and indirect allusions. I would, however, suggest that this is a subject to which a Parsi scholar might devote himself with considerable profit.

After Nahávand, the hapless Yezdijird was a fugitive who fled to Kermán and thence to Sistán. From Sistán he continued his flight to the north, and after residing for a while in Kuhistan, took refuge at Merv. Its governor invited the Tartars to seize the monarch who, however, escaped from them only to meet his death at the hands of a miller who murdered him for his jewellery. Thus ingloriously fell the last monarch of the Sasanian dynasty.

When travelling to the north-west of Yezd I heard of a most curious custom which is connected with the daughter of Yezdijird, known as the *Bánu-i-Fars* or "the Queen of Fárs." When fleeing from the Arabs she met a peasant of Ardakán and begged for a drink. He immediately milked his cow, but the malicious beast kicked over the bowl and the *Bánu* departed thirsty. In her despair she asked the earth to swallow her up, which it promptly did. The peasant, in turn, slew his almost sacred cow in expiation of its offence, and until the Zoroastrians of Bombay succeeded in substituting legitimate observances, cows were regularly sacrificed by the Parsis of Ardakán, albeit the slaughtering was done by Mohammedans, who alone ate the flesh. This custom was for Parsis a curiously perverted one.

Persia was apparently crushed by the issue of Nahávand with the exception of Tabaristan, the province lying between Tehran and the Caspian Sea where, for two centuries, the *Ispahbud* or "Commanders-in-Chief," as they were termed, continued to strike their Pahlavi coinage and maintained the worship of Zoroaster. Elsewhere it is to be presumed that most of the Persians submitted and in due course of time became Mohammedans. However, a reference to Syriac literature shows that in the latter half of the eighth century, or rather more than a hundred years after the Arab conquest, a certain divine, by name Bar Sade, wrote a polemical work against the Zoroastrians, who were thus evidently considered still worthy of powder and shot.

Elsewhere we read that, a century later, the Sámán dynasty was founded by the grandson of a convert from Zoroastrianism, in Khorasán. Again, Ibn Haukal, who travelled in the tenth century of our era, or some three centuries after the battle of Nahávand, writes as follows: "And the books of the Gabres, their fire temples and their customs and ceremonies of Gabrism or Magism, still continue among the people of Párs; and there are not, in any country of Islam, so many Gabres as in the land of Párs, which has been their capital or chief residence."* The above examples show that, although the majority of the inhabitants of Irán had speedily accepted Islam, there was still a large minority which was not only tolerated but, as in the case of the ancestor of the Sámán dynasty, was allowed to remain powerful and wealthy.

One section, from whom the Parsis of India are descended, after spending about a century in Kuhistan, made their way south to Hormuz—the modern Mináb, to the east of Bandar Abbas. There they lived 15 years, during which, I recollect reading, they played polo, and then migrated to Bandar Diu, which is not very far from Karachi. But my subject is the Parsis of Persia, whom we may regard as managing, albeit with much difficulty, to maintain their ancient cult. The laws were, however, cruel, and, apart from persecutions, and in some instances, massacres, any Zoroastrian who became a Mohammedan, was allowed to seize the entire property of his family. Thus, generation after generation, the adherents to the old religion became fewer and fewer, until to-day their number does not exceed 10,000, and it is this small but interesting community to which I purpose to devote the remainder of the time at my disposal.

My acquaintance with the Parsis of Persia dates from 1893, when I first visited Kermán and Yezd, but I met them only as a traveller until I founded the consulate at the former city two years later. At that time I recollect being informed that, shortly before my arrival, two young Parsis had been murdered by the *kalantar* or mayor, and that no attempt at redress was possible. When I add that a similar murder had occurred at about the same time at Yezd, with a similar lack of redress, it is sufficient to prove that the lot of the Parsis of Persia was gloomy in the extreme.

Nor were these outrages isolated instances

* *Vide* Ouseley's "Oriental Geography," p. 110.

of fanaticism. Far from it. What a Parsi might or, more generally, what he might not do, was regulated with a minuteness which was both brutal and childish. To take the question of clothes, no Parsi might wear anything but an ugly mustard-coloured garb, with a turban of the same colour, which latter had to be twisted and not folded. He might not ride even a donkey except in the desert, when, at the sight of a Mohammedan, he was bound to dismount, failing which he was pretty sure to be knocked off. In fact, even to-day, Parsis only ride outside the town, and then never a horse. Nor did this persecution cease in the Parsi's house. No; he was forbidden to build a wall more than seven feet high, or a house with two storeys. In short, in every way, he was treated unjustly, both by law and custom, and was mercilessly "squeezed" by the authorities, both civil and religious,* even although the odious poll-tax upon infidels, had been abolished some years previously, thanks to the representations of the Indian Parsis, which were supported by the British Government.

Upon taking up my residence at Kermán, I felt that, apart from the injustice of the case, it was greatly to the disadvantage of the Persian Government that such a hard-working and thrifty class of the community should be so cruelly discouraged. Moreover, as 90 per cent. of the followers of Zoroaster are British subjects, I extended my good offices to the small Persian community in all cases of extraordinary persecution. One of these arose a few months after my arrival at Kermán, and serves as an excellent illustration of what I have already said.

During the spring there are light rains, when all agriculturists work their hardest: but a priest threatened to kill any Parsis who left their houses during this period, on the theory that they would pollute the ground. The result was that they suffered a heavy daily loss, and in their need, they appealed to me for aid. I took the matter up strongly, and the Governor-General seized the offending ruffian and imprisoned him. Thanks to this and other enlightened actions of the Persian authorities, the position of the Parsis has steadily improved, and whereas a decade ago few of them dared to engage in trade, they are now monopolising various branches of it. They have also undoubtedly benefited by the spread of the Bábi faith, a special tenet of which is the broadest toleration.

The Parsi of Kermán is, as a rule, a well-built man with a distinctly Aryan head, in which connection we found that his anthropometrical measurements were invariably larger and indicated a higher type than those of his Mohammedan fellow-countrymen, who are a mixed race, the Parsi stock, on the contrary, being extremely pure. Compared with the Mohammedan, he is better favoured and healthier, as Zoroastrianism not only discourages but condemns fasting; moreover, smoking being forbidden, there are no opium smokers among the Parsis, whereas the whole of the people of Irán are slowly but surely becoming tainted by this terrible vice, which is spread more than anything else by the month of fasting, during which opium is first taken as a medicine.

As men of business, the Parsis drive very hard bargains, and in many ways show the spirit of a down-trodden race; but, compared with the Mohammedans, their integrity and reliability are most conspicuous, and they are frequently employed by Persian noblemen as superintendents of estates, and in other positions of trust. They are also held to be the best gardeners in Persia, which fact shows that the influence of the old religion, which held agriculture to be the only calling worth following, is still a living force. In India, too, Persian Parsis frequently work as gardeners.

The Parsi woman's dress as worn in Persia at the present day has probably remained unchanged for centuries, although latterly it has been composed chiefly of Manchester goods, instead of the old hand-woven cottons and silks. The costume consists of a loose shirt reaching to the knees, which is prepared from perpendicular strips of different coloured materials joined together very much in the way that Joseph's coat must have been made. This shirt falls over a pair of very voluminous trousers gathered in tight to the ankles, which latter garments are composed of the same material as the shirt, but even smaller pieces of stuff are employed, and they are generally embroidered together like our patchwork quilts. The head-dress consists of no less than eight coloured handkerchiefs and shawls. Firstly a black cotton or silk skull-cap, absolutely concealing the hair, is adjusted, over which five handkerchiefs are tightly knotted round the head, surmounted by a large square

* In "Five Years in a Persian Town," by the Rev. Napier Malcolm, the disabilities of the Parsis of Yezd are given at length in chap. II.

of cotton, or, in winter, woollen material which is draped in a manner peculiar to the Parsis. One point of the square hangs nearly to the ground behind, while in front the rest of the shawl forms a bib concealing the upper part of the shirt and sleeves. Finally, for out-door wear yet another shawl is worn, but this last is only folded across and thrown on loosely. A small bead or charm is often sewn on under the chin which is supposed to ward off the evil eye. Unmarried girls are restricted to two less head coverings than their elders.

No Parsi woman from earliest childhood would ever appear with her head uncovered, and the ears have to be equally screened from observation. Probably, as a result of the above custom, their hair is particularly scanty and poor, and from the same cause probably arises the fact that Parsi women complain chiefly of cold in the head. On the other hand, they never suffer from cold feet, and their custom of only wearing socks during the coldest part of the winter bears out this supposition. They possess many old customs to which they cling tenaciously, one of which is to sacrifice an animal or bird before occupying a new house. This ceremony we found one day being performed by our Parsi maids before we took possession of the new consulate at Kermán. A fowl had been the sacrifice, and it was being eaten amid the light of many candle ends which had been carefully collected for weeks in anticipation of the event. When questioned they explained that the sacrifice of a fowl and the illumination were to drive out any evil spirit which might have taken up its abode in the untenanted rooms. As mentioned above every Parsi venerates fire, and our servants salaamed whenever they lit a match, and always preferred a log of wood to burn out whether required or not. When a candle had to be put out they pinched it in preference to blowing it, as that would have been considered disrespectful. Their ideas of administering punishment may be judged by the fact that one day a terrible noise was heard which, upon inquiry, was found to emanate from a cat which had been tied up, and was receiving the bastinado on its feet for stealing their food. They are a very thrifty people especially compared to Mohammedan Persians, who are prodigal in all ways.

Before concluding this section of my subject, it is of interest to note that Zoroastrians of Persia often identify their prophet with Abraham, their object being to gain recognition for themselves as being *Ahl-ul-Kitáb* or "People to whom a revealed book (recognised by the Mohammedans) has been vouchsafed." Such people, *i.e.*, Christians and Jews, are accorded a much higher position than the heathen in Mohammedan theology and, although hopelessly doomed to hell, their hells are higher up than those of the people without a book. That this is no new claim is proved by a passage wherein Josafa Barbaro, the famous Venetian traveller of the fifteenth century, mentions that "Thense (sc. from Yezd) ye go to Meruth, a little towne, and two daies jo-rney further is a towne called Guerdi, in the which there dwell certein men called Abraini, which in myne opinion either be descended of Abraham orells have Abraham's faith, and they weare long heare." *

It is interesting to note that the people of Guerda or Agda term themselves *Seiids* or descendants of Mohamed; but they also acknowledge that they were Zoroastrians until a century ago. It was apparently the custom to give converts to the Mohammedan religion some title, whence their claim to be *Seiids*. Agda is close to Ardakán, which was referred to in connection with the "Queen of Fárs."

I now come to the important question of education which, until the present generation, was not merely non-existent, but was forbidden. I have already referred to the reimposition of the hated poll-tax. So far as I know, this was the first occasion which moved the Parsis of Bombay to think of their less favoured co-religionists. A sum of money was collected to aid the Zoroastrians of Persia, and when, thanks to the unremitting persistence of Mr. Manakji Hanteria, the odious tax was finally abolished, the surplus money formed the nucleus of a fund for educational purposes, under the auspices of a body, termed the "Zoroastrian Amelioration Committee," which is composed of some leading Parsis of Bombay. Only £40 per annum of this amount is apportioned to Kermán; but the local Parsis have helped themselves to some extent and, at present, there are a considerable number of boys who are taught Persian, while a few were, until recently, instructed in English. The schoolmaster was, however, badly paid, the Parsis of Bombay gave no help, and, at present, no English is

* Travels of Venetians in Persia, p. 82 (Hakluyt Soc.). For a fuller account of the itinerary of Josafa Barbara, see my "Ten Thousand Miles in Persia," p. 155, *et. seq.*

taught. Among my pleasantest recollections at Kermán are the speech days, at which I presided, as one could not but sympathise with the efforts that were being made towards progress, albeit I felt keenly that the crumbs from some rich Parsi's table would suffice to put matters on a proper footing. In 1902 I interviewed the members of the committee at Bombay, and did my best to enlist their sympathies and, although their views appeared to me to be a little lacking in breadth of outlook, the matter has not been dropped, and a Parsi millionaire proposed an excellent scheme for helping the Zoroastrians of Persia, which he has not, however, as yet, been able to carry through. There are but few occasions on which an Indian official can speak *urbi et orbi*, and I mean to take advantage of the present opportunity and conclude this paper with the following message to the Parsis of India. I would say, "You are an extremely wealthy but numerically small community, of which 90,000, who are not increasing in numbers, reside in India, and 10,000 in Persia. The larger section in India is educated and progressive, but is, physically speaking, somewhat nervous and less vigorous from a residence of many generations in the enervating climate of India, and an almost total relinquishment of agriculture. The Persian section, on the other hand, is finer in physique and appearance than yourselves, but is backward in all that makes for progress. Is it not then your bounden duty and your obvious interest to provide adequate funds to educate and help your backward section? Is it not to your obvious advantage to push development and trade in Southern Persia, and, in the process of such development, to send as many of your sons as possible back to the glorious climate of Irán?" I am astonished that no Parsi of means has taken up this problem, which, apart from the wide future it opens up, would revitalise the whole Zoroastrian community, which otherwise seems threatened with extinction. I know that the Parsi leaders of Bombay plainly told me that they feared the dangers and hardships of Persian travel; but surely all Parsis have not become soft from a surfeit of prosperity. I also saw monuments of Parsi munificence all over Bombay, and it struck me that the Zoroastrians of Persia, who have no doctor or dispensary of their own, had a claim on all this, but had been forgotten.

I do not know whether my words will produce any effect, but I foresee that the destiny of the Zoroastrians is bound to their ancient home of Irán with links of steel, and that the Parsi who assists to fulfil that destiny will leave a name behind him that will outshine in lustre that of all the merchant princes of Bombay.

DISCUSSION.

The CHAIRMAN said he understood that his duty at this stage of the proceedings was to stimulate the shrinking eloquence of the distinguished men who sat around him on the platform, by making a few observations himself, and, therefore, he proposed to conform to that unhappy practice. He would not follow Major Sykes into his disquisition on the early history of Persia, or the religion of Zoroaster. He was somewhat relieved to hear that those studies had led the author not only to regard Zoroaster as a definite historical personage, but that he was even able to tell his audience the date of his birth and death. He (Lord Curzon) confessed, however, that glad as he was to believe what Major Sykes had told them, his own studies had led him to think that Zoroaster was a rather shadowy and nebulous person; while he once read a learned essay, written by a distinguished Professor, who argued that Zarathushtra or Zoroaster was no more than a product of the ubiquitous storm myth of the ancient world. But he would not follow Major Sykes into those obscure, though interesting by-paths of hypothesis; the little he had to say would be confined to the subject of the Parsis in Persia. He was sure his audience would agree that there was something sad and pathetic, though at the same time ennobling, in the spectacle of that ancient religion, which was once the faith of the entire country, which had twice been the official creed of ruling dynasties within it, surviving through twelve centuries of insult and persecution, to the present day. Throughout that time, the Parsis of Persia had preserved, with extraordinary success, the purity not only of their religion but of their race; and to this day, as Major Sykes's observations justified one in believing, they retained all the marks and idiosyncrasies of a distinct nationality. It was impossible to look at the pictures which had been exhibited on the screen without seeing that the men were of a very marked and virile type of character, and that a people with features so clearly marked, and with an aspect in some cases so distinguished, were worthy of a better lot than that which they had been permitted to enjoy. It was also remarkable that throughout all these centuries of suffering and humiliation, the Parsis of Persia, as a community, had always been loyal to the Sovereign under whom they resided. They had been conspicuous for a high standard of honour in their commercial relations also, as well as for their hard work in the ordinary avocations of life. They ought, he thought, to be of special interest to us, both because of their connection

by blood with our fellow subjects in India, and because a great many of those in Persia were British subjects already, men who came from India; and also because it was largely owing to the British protection which had been afforded them that their condition had been a good deal ameliorated in recent years. The author had stated that the total number of the community in Persia was about 10,000, of whom some 7,000 were at Yezd, and nearly 3,000 at Kerman and its villages. He (Lord Curzon) remembered coming across small colonies of them in other places, namely at Teheran, Kashan, and Shiraz, and in those places they were almost entirely occupied with gardening, in which they excelled. He was not fortunate enough to visit any of their temples; indeed, the temples of such small communities could not have been large, but he remembered seeing their *dokhmas* very different from those buildings amid the palm trees of Bombay, which were so picturesque, and which some one with a poetical fancy had designated "Towers of Silence." The former had a good deal of silence about them, but very little poetry. He commonly found them situated on forlorn spurs of rocky elevations; and they seemed, in Persia, to symbolise the decline and decrepitude of the race. Major Sykes had also given a very interesting account of the cruel and almost heart-rending disabilities from which those unfortunate people suffered so long. Their condition up to twenty years ago was truly deplorable, and one of the points most to be set down to their credit was the uniform patience with which they had borne it. But the position of the Persian Parsis had now much improved, and that could be attributed to a number of reasons. The first was the enlightenment which was in some measure making its way into that fanatical and priest-ridden country. Secondly, it was due to the interest, the rather languid interest, of their co-religionists in Bombay. Thirdly, it was due to the power of organisation and self-help which had been to some extent conceded to them in recent years; they were permitted to form a society for the protection of their own interests. And, lastly—and this was a reflection of which it was pardonable to be somewhat proud—it was due in a large measure to British interest and British protection. It was very largely owing to British help that that invidious and odious poll-tax was abolished in 1882, and there was not an English traveller who had been to those parts of Persia who had not shown an interest in the welfare of those unfortunate people. The best account of them which he had read was in a very notable book which came out twelve years ago, written by Mr. (now Professor) Browne, of Cambridge. He spent some time at Yezd and Kerman, and cultivated the society of the Guebres or Parsis, leaving a most vivid and sympathetic picture of their condition and character. But the interest of the British in them had not been confined to the few British travellers who had got so far; it had been conspicuously illustrated by all the British officers who served officially in those parts, and most of all by Major Sykes himself. He now approached the concluding portion of Major Sykes's address; that in which he made a strong, but not, he thought, an unduly strong, appeal on behalf of the Persian votaries of Zoroaster to the wealthy, comfortable, and enlightened Parsis of Bombay. He joined in that appeal, with all the earnestness and intensity in his power, and he knew something about the matter. It was while he was in India as Viceroy that the question came before him officially. It was known that, mainly owing to the action of Major Sykes, the matter was being raised at Bombay, and that proposals were being adumbrated for giving greater help, particularly in the way of education, to the poor Parsis of Kerman. There was a proposal to devote certain sums to the education of the young men of that community in Kerman itself; but, sympathetic as he felt, he did not feel justified in giving any portion of the revenues of India, contributed by the Indian taxpayers, to the subjects of a foreign king in a foreign country. Still, when the question was raised of bringing some of the Persian Parsis to Bombay, and giving them a share in the advantages of the education existing there in so marked and highly developed a degree, he thought the Government of India might not unreasonably help. But at that stage, for reasons quite unknown to him, the whole scheme came to the ground. He rather gathered from Major Sykes's remarks that he attributed it to the enervating climate of Bombay, and he did not know whether the Parsi community in that city had, in any degree, succumbed to those influences; he hoped not. He had not himself observed signs of it, though it might be that to some extent they were yielding to the influences of the much higher standard of civilisation and comfort by which they were now surrounded. But however that might be, the Parsis of Bombay remained the most businesslike, the most intelligent, the most loyal, and, what for the purpose of this appeal was even more important, the wealthiest section of the community in the Western parts of India. In the spirit prevailing now-a-days, when race feeling was so strong that people were always looking up and enquiring about those who had the same origin as themselves, in all parts of the world, when one saw the wealthy Jewish community in England, presenting certain features of resemblance to the Parsi community in Bombay, exerting themselves by organisation and co-operation and by large gifts of money, to improve the condition of their miserable Jewish brethren in Jerusalem and other distant parts of the world, were the Parsis of Bombay going to lag behind? They would only be conforming to the spirit of the age, and would be satisfying the dictates of their own naturally noble nature if they listened to the appeal which Major Sykes had addressed to them in his paper. He, therefore, earnestly hoped that the proceedings that

day would result not only in the poor schoolmaster getting the £10 which Major Sykes could not obtain from the Parsis at Bombay—he would have given it himself if he had known—but that a steady flame of interest might be aroused in Bombay in support of the welfare of those people, and that, henceforward if the words from that meeting were heard, a brighter future might lie before them.

Sir George Birdwood said the welcome given to Major Sykes on entering the room sufficiently indicated the reputation he had earned among the members of the Society of Arts by his previous paper read before them, in 1897, on "Kerman and Persian Baluchistan," while the applause with which his present paper had been received proved that it had not only maintained but advanced his position among them. The paper had the interest necessarily given to it by a man who travels with a serious purpose, was well read in the writings of those who have travelled the same way before him, was a quick, accurate, and discriminating observer, and able to record his impressions compendiously and effectively. The Persian poet Saadi wrote:—"The traveller without observation is like a bird without wings." Major Sykes was not only himself winged with the power of observation, but by his suggestive touches of description and illustrative photographs, had provided all of them with, as it were, wings to follow him with ease and zest in the swift sweep of his bird's-eye review of the land of modern Iran, and of the material and moral condition of the remnant of its ancient Parsi people. The interest of the paper had been also heightened by the presence in the audience of so many notable Parsi gentlemen and ladies from Bombay. The latter, in their dazzling classical robes, grouped under James Barry's symbolical paintings, would not fail to remind the readers of Herodotus of the winter palace of the Achæmenian kings of Persia in the Memnonia of Susa, and to recall to them the magic names of Atossa, Artystoné, and Phratagune, Mandané, and Cassandané, Parmys, Amytis, and Amestris, Artazostra, and Rhodoguné,—all imperishable names. He (Sir George) could only notice in any detail one or two quite casual points in connection with the paper. The Parsis were never more than a fraction of the Aryan people who ever since the time,—anterior to the date of the Sargonids — they entered the elevated tableland between India and Asia Minor, had given it, throughout Asia, the name of Iran; but which, for the last 2,000 years, had been known throughout Europe by the name of Persia. These Aryas entered Iran from the North-East, settling successively in Sogdiana, Bactria, Carmania, ? Gedrosia, Parthia, Media, Parsa [in the mouth of Arabs Fars] *i.e.* Persia, and Susiana [Ansan, Elam, or Khuzistan]. The "Cylinder of Cyrus" described him as "King of Ansan," and again as "King of the Nomads, the great King, the mighty King, the King of Babylon, and the whole of Sumer and Akhad [lowland and highland Chaldaea], and of the four quarters [of the Earth]." Nowhere was he styled simply King of Persia. The Behistun inscription of Darius described him as "King of Persia and its dependent provinces;" but by "Persia" he merely meant the palatine province of Parsa, *i.e.* the modern Fars, along with which he named, as dependent provinces, Sogdiana, Bactria, Parthia, Media, &c. In all the inscriptions of the Achæmenids it was always "King of Persia, and Media, &c.; "Parsa *uta* Mada;" "Mada" here meaning either "Middle land" or "Mother [Madre] land;" [compare "*Bhande Mataram*," "Hail motherland."] The whole country between the Tigris and Euphrates and the Indus, was the "Aryan"-land, Iran, and Persia was only Fars. But in the West, from Armenia and Syria to India, it was all Persia. This was simply due to the superior vigour and domineering abilities of the Aryas of the palatinate of Parsa, who in the eyes of the Greeks represented the various Aryan tribes of Iran. Now, Admiral Sir Edmund Fremantle speaking here recently, remarked of the Parsis of Western India, that although only a fraction of the inhabitants of the loyal town and island of Bombay, they, by their all pervading energy and all sustaining industry, and strenuous activity, and helpfulness, gave a stranger the idea of their being the only inhabitants of the place! That was very pertinent proof that the modern Parsis still upheld the virtues of their ancient race, as described by Herodotus, and indeed that they had improved on them. Major Sykes was justified by the results of the recent researches of Zendic scholars in maintaining the authenticity of the personality of Zoroaster; but he had stated in too unqualified a manner the indebtedness of the Hebrews to the Zoroastrians for the doctrine of the resurrection of the body and the immortality of the soul. The passages in Isaiah xiv., describing "Hell from beneath being moved" for the tyrant kings of Babylon "to meet them at their coming" in all their pomp and train; and again in Ezekiel xxxii. describing the peopling of Hell with all those "slain by the sword" in the fearful downfall of Egypt, Assyria, and Babylon; and other similar passages [Isaiah v., &c.]; surely they suggested that the Hebrews must have had some intimations of a future state before they came into contact with the Persians [Maimonides]. It might be noted that the Hebrew Prophets never place the Persians in "Hell," or denounced God's judgment on them. [The "Persia" of our A.V. of the Bible in Ezekiel xxvii. and xxxviii. is not Persia, but Paras, a Lybian land, tentatively identified with the Pharusii of Pliny.] On the contrary, Cyrus was described by them as "the Shepherd of God," and "sent to do His pleasure" [Isaiah xliv.], and as "the Anointed of God" [Isaiah xlv., and see also Ezra i., iii. iv., and v.]; and it was clear that the Hebrews recognised in the Zoroastrians not only political deliverers, but a people

of a religion cognate with their own; which had an immense influence on Judaism, in internationalising and humanising it, and in preparing the way for Christianity, as the apotheosis of mankind in the self-sacrificing service of man. Major Sykes had been misled probably by the false etymology, for some time current, of the word Pharisee, which derived it from the word Parsi, and gave to it the meaning of "the Parseeising Hebrews," or those Hebrews who believed in the resurrection of the body and the immortality of the soul. But the word "Pharisee" is simply the Hebrew *perusim*, "the select," and was applied to the Pharisees as an epithet of opprobrium, in the sense of "straight laced," and "unco guid" by their sectarian and political opponents. The Scribes were the educated classes of the Hebrews, the doctors, the lawyers, and teachers, and of these the Pharisees were the high and dry Churchmen, and Conservatives, and patriots of their day, and the Saducees the contemporary Agnostics, "smart set" and "Little Englanders:" and strange to say it is their nickname, *Saddukim*, which is old Persian, or Semito-Persian, being cognate with *zindikun*, "infidels," applied by the Parsis of Iran to the heterodox Zoroastrians, who while accepting the authority of the Commentary on the Avesta, denied the divine inspiration of the Avesta. Nevertheless it is impossible to exaggerate the elevating impulse given by Zoroastrianism to Judaism, and to all the ancient religions with which it was brought into contact by political, commercial, and social intercourse between the peoples of antiquity. The Persians were the Protestants of antiquity. They overthrew the immemorial and stupendous seats—"Satan's Thrones"—of idolatry in Assyria, Babylonia, and Egypt. Later, in the intellectual and spiritual competition between Neo-Platonism [Hypatia], Christianity, and Zoroastrianism, it was long doubtful which would prevail as the religion of Europe; and it was only the severer organisation, and sense of discipline, impressed on Christianity by the legal minded priesthood at Rome, which secured its triumph in the West. From even the brief summary of Zoroastrianism given by Major Sykes, one sees at a glance how much Christianity, not only that of the historical churches, but of the New Testament, owes to Zoroastrianism. The Book of Daniel, and the Revelation of St. John the Divine, are pure Zoroastrianism; while there is nothing in all the sacred literature of the Parsis that gives a clearer and more dramatic exposition of the angelology, eschatology, and general theology of the Parsis than Bunyan's "Pilgrim's Progress," and "Holy War." There was no time to add anything on the subject of the advancement of British commerce with Persia, but he might briefly say that there could be no advancement in Persian commerce without improvement in Persian agriculture, and that was dependent on the reforesting of Persia, that is on restoring to Fars and Khorasan their ancient state of fertility; and this could not be effected without a more intelligent and more honest system of administration in Persia. The special obstacles in the way of the Parsis and Englishmen entering individually into trade relations with Persia was the jealousy of the Persians of them; the abominable system of credit [*busti*] prevailing in the country; and the shameful failure of the British Government to afford their subjects in Persia proper protection and support. In conclusion he would wish to give some expression, however inadequate, to the gratification they must all feel in seeing Lord Curzon again occupying the Chair at one of the meetings of the Indian Section of the Society of Arts. His Lordship, in early manhood, recognised that what was required of all statesmen—the men whose instinct is to steer the ship of state, and not to let it drift, as the politician is content to do—was—beyond a knowledge of books, even Bluebooks—a wide knowledge of the world, and intimate intercourse with the people of all countries. This was more particularly required of English statesmen, responsible for the beneficent direction of the destinies of the most widely scattered and promiscuously constituted Empire the world has ever seen. His Lordship has proved the practical value of the training in which he has kept himself by adventurous travels both in the near and the far East, in a vice-royalty that has added a brilliant chapter to the heroical history of the British *Raj* in India. That his Lordship should be presiding over us here that evening was an honour they one and all most gratefully appreciated; and it was most gratifying to them as showing, that after seven years of "splendid isolation" in the highest service of the Empire, there was no abatement of his spontaneous, and unstrained interest in the ever growing, and truly national and imperial work of the Society of Arts.

Sir M. M. Bhownaggree, K.C.I.E., said there could be no two opinions as to the very engrossing and interesting nature and character of the address which had been delivered by Major Sykes. Time prevented him (the speaker) from dwelling at length on the various points of the extraordinary and sympathetic acquaintance which Major Sykes had shown both with the origin of the Parsi religion and with the beginnings of Persian nationality. He had himself been of the belief, from his studies of Zoroastrianism and the Christian Holy Writ, that there were many points of resemblance between the ordinances of Judaism and those of Zoroastrianism, and he thought the author had done full justice to the fact by his critical and informing remarks. They had heard with painful interest that the condition of the Zoroastrians in their fatherland had been one of great hardship and oppression. At the instance of the Zoroastrian Amelioration Society of Bombay it had been his privilege with many of his Parsi colleagues in London to approach the Shah on two occasions in recent years, and he believed that as a result of their representations many of those reforms and privileges

which were mentioned by the author had been vouchsafed. In the appeal made by the author there was something almost approaching an aspersion upon the charitable instincts of the Parsi community. But he attributed that to the exceedingly keen interest taken by Major Sykes in the lot of the Persian Zoroastrians, and therefore he was not disposed to quarrel with the appeal, but rather to thank him for the zeal he displayed in their welfare. He would also like to thank the noble chairman for the very powerful appeal with which he backed up Major Sykes's appeal. Near him sat a well-known philanthropist, Mr. Petit, a member of the Amelioration Committee, who told him that they had funds enough and to spare for any such purpose, and that if necessary the Parsis of Bombay would gladly put their hands into their purses and come forward to assist their Persian co-religionists in any manner that Major Sykes might indicate. He believed that neither the noble lord in the chair nor anyone in the audience would suspect that the community which had done so much for the cause of charity in India, which had produced such benevolent men as the great Sir Jamsetjee, and which embraced such men to-day as the Petits and Tatas, would refuse to make a splendid and sufficient response to Major Sykes's appeal. The gentleman to whom he had alluded had recently given five lakhs of rupees to build a special hospital for Parsis. Those present might therefore rest assured that the appeal would not fall upon deaf ears, but that charitable Parsis would do their utmost to ameliorate the condition of their Zoroastrian compatriots in their ancient fatherland.

Dr. JOHN POLLEN, C.I.E., desired to make a brief announcement. He had known Parsis, not only in their palaces in Bombay, but in the field and toddy groves up country. Some of his best and truest friends belonged to this great community, and he felt certain that they would respond at once to the appeal made to them on the present occasion. He had pleasure in stating that a Parsi gentleman, who desired that his name should not be divulged, was prepared to pay Major Sykes £500 in response to his appeal.

The CHAIRMAN said the statement just made was a very gratifying one, and he was sure every one was much pleased. It now only remained to thank Major Sykes for his interesting paper. It was not the first time Major Sykes had read a paper before the Society of Arts, and it was to be hoped that it would not be the last. If one of the discs shewn on the school children in one of the photographs, indicating a thousand congratulations, albeit made of paper and costing nothing, were in the possession of the meeting, it would be at once hung round the neck of Major Sykes.

Sir WILLIAM LEE-WARNER (Chairman of the Indian Section) said other speakers had expressed the gratitude of the audience to the reader of the paper for the most pleasant and interesting afternoon which had been spent, but none would leave the room without adding a grateful acknowledgment of the services rendered by the Chairman to the Society, not merely by his attendance when he had so many duties to perform, but also by the stimulating remarks which he had made. It would prove to be a red-letter day in the Society's annals if, as now seemed assured, the meeting just held should cause to well up in the midst of Yezd a spring of charity fed by the Zoroastrian Parsis and others in Bombay which would bring solace and means of improvement to the people who had been so vividly portrayed in the paper.

The vote was carried unanimously, and the meeting terminated.

Colonel C. E. YATE writes:—My wanderings in Persia have been mainly confined to Khorasán and Seistan, and I have never visited Kerman or Yezd, nor have I been much thrown in the way of the Parsis or Gabrs of Persia, but the Indian Parsi is well known to all Indian officials, and I am specially glad to see so many of them, both gentlemen and ladies, present here to-day, shewing the interest they take in their co-religionists of Persia. I do not speak of the wealthy Parsi merchants of Bombay, but of the Parsi traders and clerks whom one finds all over India, but especially in out of the way places where the Parsi is often the pioneer trader, and where his enterprise is well-known. The last four years of my Indian life were spent in Baluchistan, and there we had a most representative body of Parsis, amongst whom were several hard-working and prominent men who were a credit to their race, and who took a leading part in everything that went on. Two of these were first-class magistrates and also members of the Quetta Municipal Committee, and one of them so distinguished himself by his philanthropy as well as by his enterprise, that I am glad to say his services were rewarded by the grant of the Companionship of the Indian Empire, bestowed upon him by his Excellency the then Viceroy, who has so kindly presided over this meeting to-day, and whose inspiring and sympathetic address will, I hope, penetrate to the hearts of all Parsis. Well, this Parsi at Quetta started a scheme for a Parsi colony, which I was much interested in, and to which I would have gladly assigned land could any Parsis have been induced to take up the land when given; but I regret to say the scheme, so far as I know, has not yet come to anything. There is some excellent land available in Baluchistan on a new canal that I made, and I feel sure my successor will be just as ready to help the Parsis to take to agriculture as I was, but I fear the time has passed for this, and that it is hopeless to

expect Indian Parsis ever to take to agricultural pursuits again. Whether Persian Gabrs can be induced to emigrate and take up land in Baluchistan is a question that has yet to be solved, but I see no reason why they should not do so, and I would commend the idea to those wealthy Parsis in India who wish to befriend their poorer brethren in Persia. Not only has the Indian Parsi given up agriculture, but he will not even enlist as a soldier. In all my 37 years in India, I can only recollect the case of one Parsi who entered the Indian Army, and he was given a direct commission as a jemedar in an Indian cavalry regiment and served with credit in it through the Afghan war, but retired I believe shortly after. Yet Parsis would make excellent soldiers. Some of the keenest men in the Baluchistan volunteers are Parsis. Many of these are clerks serving in the various Government offices in Quetta, and the devotion and attention they give to military duties is most exemplary. There is everything to show that Parsis would make good soldiers, but soldiering is a profession that none of them take up in earnest, nor do I think it is likely that they will do so. Indian Parsis are equally reluctant to go to Persia. Major Sykes in his message to the Parsis of India, which we have just heard with such interest, urges them to push development and trade in Southern Persia and to send as many of their sons as possible back to Persia. I fear though it is hopeless to expect these sons to go to Persia or if they go to expect them to stay there. I have never yet met a single Parsi who had been to Persia and who was content to remain there. It is to the charity of the rich Parsis in India, rather than to personal contact that we must evidently look for the future regeneration of the Gabrs of Persia, and it was with much pleasure and interest, therefore, that I listened to the announcement of that liberal gift of £500 in aid of Major Sykes's proposed Parsi hospital and dispensary, and I trust this donation is the forerunner of many more. The interesting historical account of the Parsis in Persia that Major Sykes has given us cannot fail to produce its effect, and to stimulate the Parsi race to further exertions on behalf of their Zoroastrian brethren in Persia, in which no one can wish them greater success than myself.

THE SINAI PENINSULA.

The recent dispute with Turkey has drawn attention to this peninsula, and attention may be directed to the paragraphs in Lord Cromer's Annual Report on the Affairs of Egypt and the Soudan referring to it. They give a very interesting account of the country and its people. The whole of the peninsula, writes Lord Cromer, is a vast waste land. Only a few shrubs and trees grow in the valleys; water from several springs flows some distance from the hills, and then disappears in the sand without any great benefit being derived from it. The population is very sparse, about 30,000. They are all of Arab origin, save the small Gebabir tribe, believed to be the descendants of the troops sent by the Emperor Justinian, early in the sixth century, to defend the Sinai Convent against the attacks of the indigenous population. The system of justice is founded on old tribal customs, and the system of taking blood money and hereditary "vendetta" exists in full force. If a man kills another in time of peace, the relations of the murdered man, beginning from the father to the fifth generation, have the right to revenge or pardon against the receipt of blood money from the murderer or from his near relatives to the fifth generation. Should any of the near relatives of the man accept blood money all the other relations are bound to accept, and revenge by shedding of blood becomes illegal. The blood money, according to Sinai laws, is fixed at forty-one camels. It is generally paid in instalments, during periods varying from a month to a year or more. If the murdered man was of the same tribe as the murderer, the latter, or his near relatives, have to give a girl in marriage to one of the murdered man's relatives without receiving the usual dowry. She remains with him until she brings forth a child, when she becomes free to go back to her tribe or to remain with her temporary husband. In the latter case the husband has to pay the usual dowry or to renew the marriage. Five camels may be substituted for the girl.

If a man kills another in a desolate place and denies the crime, but is subsequently found guilty, he is fined four blood moneys. Should the relatives of the murdered man take revenge by killing one man of the tribe of the murderer, they still have the right to receive three blood moneys. They generally take one blood money, forgive for another, and give up the third as alms for the souls of the dead.

There is an elaborate and intricate judicial system, with many categories of judges. One is the judge who deals with all criminal cases where witnesses are not forthcoming. He tests the suspected person by fire, by water, or by dream. Testing by fire is carried out in the following manner:—The judge places an iron pan in the fire until it is red hot. He then wipes it three times with his hand, and gives it to the accused to touch three times with his tongue. If marks of burning are shown on the tongue the accused is pronounced guilty. It is thought that if the accused is guilty, his tongue dries up from fear of being discovered, and that it will be burnt, but that if he is not guilty the moisture on the tongue prevents it from being burnt. Two experts sit with the judge to witness whether the tongue of the accused is burnt or not. The test by water is as follows:—The judge sits with the accused and the spectators in a circle with a copper jug full of water placed in the centre. This jug is then made to appear to move round the circle by means of witchcraft or hypnotism. If the jug returns back to the judge, the accused is pronounced not guilty, but if the jug stops opposite the accused, he is pronounced guilty.

A curious system exists as regard witnesses. If the

evidence of a witness results in the conviction of a thief, he is entitled to receive £4 for every camel which his evidence has convicted the thief of having stolen, although where large numbers of camels are concerned, some arrangement as to the amount of payment is generally made beforehand. The Bedouins argue that a witness, whose evidence is paid for, is much more likely to be careful of giving it than one who has no possibility of profit, because the paid witness knows that every word he utters will be severely questioned before it is accepted. There are four kinds of oaths accepted in the Courts of Justice. The first consists in the judge drawing a circle, making the witness stand in the centre, and repeating the name of God six times, after which he is called upon to state his evidence. Under the second system the plaintiff places his hand on the defendant's head, and makes him repeat the name of God six times before giving evidence. Under the third system the plaintiff places his hand on the defendant's girdle, and makes him repeat the name of God three times before giving his evidence. Under the fourth system the witness takes a branch of a tree in his hands and says, "By this branch, and the Lord who makes it green and dry, I give this evidence."

As regards marriage customs, it appears that the usual dowry of a bride is five camels paid to her father by the bridegroom. On the receipt of the dowry, the father takes a small branch of a tree in his hand, and addresses the bridegroom in the following terms:—"This is the branch of my daughter, whom I give you in marriage according to the law of God and his Prophet. You are responsible to supply her with food and clothing, and bring her all she requires provided you can afford it." The girl is never asked her wish as regards her first husband. The newly-married couple spend their honeymoon in the hills away from their encampment. If the girl does not like her husband, she deserts him and takes refuge in the house of one of her relations, who endeavours to obtain a divorce for her. A divorced woman is never forced to marry anyone against her will.

GOVERNMENT SUPERVISION OF RAILWAYS IN FRANCE.

All railways in France, whether the property of the Government or of companies, are subjected to the same national supervision. When a company obtains the right to build and work a railway, conditions are imposed by which the property may be, at some future time, acquired by the nation. According to the American Consul at St. Etienne, the management of national control under the laws of 1881, of the working of each railway system in France, is entrusted to Inspectors-General of Roads and Bridges, residing in Paris, who have seats on the councils and committees instituted by the Minister of Public Works. These inspectors are invested with authority to consult the books, papers, reports, &c., of the railway company to which they are assigned, as well as any documents necessary to reveal the condition of the company and the correctness of the receipts and expenditure. The Inspector-General assists at, or is represented at, all the meetings of the shareholders of the company, and has under his control (*a*) the railway track and buildings, and (*b*) the technical and commercial working of the railway. When necessary he inspects and controls plans and designs of new lines. The control of the track and edifices comprises supervision of new construction and repairs on lines, and verification of the expenses incurred. The Inspector-General is assisted by a Chief Engineer of Roads and Bridges, several ordinary engineers, and a staff of clerks. The control of the technical working of the line comprises the supervision of the motive power, rolling stock, workshops, verification of accounts, and a strict surveillance over the observance of the regulations concerning the work of the *employés*. That of the commercial operation embraces the study of rates and all commercial questions affecting the railway system, examination of the budget of the company and the verification of accounts. By a decree of 1901, the study of the former questions is entrusted to a director of commercial control assisted by a general controller of each company, several inspectors and commissaries of surveillance. A Government director is, by right of office, a member of the consulting committee of railways, and can assist at any of the railway directors' meetings as well as at the general meeting of the shareholders. The duties of this office are very important. The official director must make himself acquainted with the needs of the population, and examine with care all propositions to change rates, and report thereon to the Minister of Public Works. Although officially residing in Paris, he is invited to study the industrial, commercial and agricultural affairs of different districts in the provinces, and goes about frequently to visit the Chambers of Commerce, and the syndicates for the proper understanding of local claims. Besides these inspectors and their staff of assistants, the Government appoint a class of agents called Commissaries of Surveillance, who are attached to every large station under the control of the State engineers or inspectors. Another class of agents is appointed to see that the railway company observe the State regulations as regards the *employés* of the company, the running of trains, and the rotation of enginemen and firemen. The consulting committee attached to the Ministry of Public Works is composed of the President of the Senate Committee on Railways; President of the Chamber Railway Committee; President of the Public Works Section of Agriculture, Commerce and Industry; Director of Railways attached to the Ministry of Public Works; Director of Roads, Navigation and Mines; Director of the State Railways; a member of the International Railway Congress, and two workmen or

employés of the railway companies. Besides the above, must be mentioned several deputies and senators, members of the Chambers of Commerce, engineers, &c., or 75 in all. The committee is presided over by the Minister of Public Works, or in his absence by a vice-president. The members are appointed for two years, but can be re-appointed. The committee must be consulted on questions of rates, interpretation of laws and regulations relative to the commercial working of railways, acquisition of property conditions imposed on companies, regulations passed by the administration of the railways, and submitted for the approval of the Minister, requests for authority to issue bonds, building of railway stations, demands on the part of the public relative to the running of trains, &c. The committee deliberates and gives its advice on all questions submitted to it by the Minister of Public Works on the general working of railways and the organisation by the companies of pension funds for their *employés*. A meeting is held at least once a week, and more frequently when necessary. No rates of any kind can be imposed by the railway companies unless they have received authorisation from the Minister of Public Works. Before applying any tariff or rate, the companies have to draw up a list or schedule of the prices they intend to charge for the transport of passengers, cattle, merchandise, and various articles. Copies of this schedule are transmitted to the Minister, the Prefect of the department traversed by the railway, and to the Control Service. For accessory expenses, as those of loading, unloading, storage of goods, and warehousing, as well as all other rates determined annually, the companies must submit the schedule for the approval of the Government, in the month of October in each year. These schedules, when approved, are posted prominently in the stations for public information. At the expiration of a month the schedule enters into effect. The companies are bound to carry with care, celerity, and without favouritism, merchandise, cattle, and all other articles entrusted to them. Government supervision of the working of railways is exercised by the Engineers of Roads and Bridges, by the agents of the Control Service, as well as by the inspectors of the commercial working of the lines, and the Commissioners of Administrative Supervision. To any or all of these agents the companies are bound to produce their books and all documents that may be required. When an accident happens on a railway, a declaration is made by the company or by its agents to the Commissary of Surveillance of the locality. When it is attended with loss of life the company must inform without delay the Minister of Public Works, the Prefect of the Department in which the accident occurred, the Public Prosecutor, and the State Engineers. In each station a special memorandum book is kept to receive any complaint against the company or its agents, on the part of the travelling public. A copy of the complaint is sent immediately to the Commissary of Surveillance of the district. The Prefect of each Department imposes a series of rules or regulations applicable to the maintenance of good order, and these are prominently posted up about the railway stations. The stations must be kept clean, and must be well adapted for the comfort of passengers. *Employés* must be in sufficient number to ensure the proper working and supervision of the signals, switches, and every other apparatus necessary. All gates at level crossings are under the control of the Minister of Public Works, their form, method of working, &c., being prescribed by him. The intersection of a railway by another railway, or tram line, must also receive official sanction. Locomotives, tenders, and carriages of all kinds for making up a train must be constructed according to the best models and with the best materials. The condition of service of all locomotives is inscribed on a register and kept constantly up to date, indicating for each machine the date of its first journey, the work it has accomplished, the repairs it has received, &c. A special register is kept for the axles, in which is marked the number of an axle, where it was made, when it was first used, its work, accidents, and repairs. These two books are placed at the disposal of the Government officials attached to the company. The axles of all the carriages bear marks indicating where they were manufactured, and the date of their entry into service. No locomotives are allowed to run except by authorisation delivered by the controlling agents, and after undergoing all the trials prescribed by Government regulations. Each engine must be provided with an apparatus to prevent live coals from falling on the line, or flaming particles escaping from the chimney. The company is liable for damage from this cause. The carriages are required to be comfortable, and to have the number of seats posted in each compartment. No carriages can be put into use without the authority of the State agents. The companies must advise the Minister of Public Works of every measure adopted to keep the rolling stock in repair. Every locomotive on goods and passenger trains alike, must be accompanied by an engine driver and a fireman, the latter capable of stopping the train, and by a certain number of guards. The maximum number of carriages of each class in passenger trains is fixed by the Minister on the proposition of the company. The passenger trains must be driven by one locomotive only, unless additional power is found necessary by reason of extra passengers, of steep gradients, special atmospheric conditions, or on account of some accident. When more than one locomotive is used, the fact must be mentioned in a book kept for the purpose, giving the reason why the second engine was employed, the station where it was found necessary to attach it, and the time when the train left that station. The Minister of Public Works regulates, in conjunction with the company, the transport of dangerous materials (explosives, inflammable liquids, &c.), and he determines, notably, the cases where the transport of these goods by a passenger

train is forbidden. No trains may leave a station before the scheduled time; for the arrival, a certain tolerance is granted by the Minister. The interval between the departure of two trains following each other is fixed by the State agents. The speed of the train over different sections of the line is determined by the Minister, as also the special precautionary measures in sending extra trains. At certain places along the road fixed by the Minister, locomotives with steam up must be held in reserve in case of accident. Special registers are left at the stations in which are noted train delays exceeding five minutes. The books must show the nature and composition of the train, the mileage it travels, the locomotive number, hour of departure, and all delays. These books must be produced at the request of the Government agents. A copy of the rules and regulations laid down by the Minister of Public Works is posted up in every station, another is given to the guard of each departing train, while extracts relative to their duties are delivered to the engine drivers, firemen, gatemen, and all other servants of the railway companies.

THE ARMS INDUSTRY OF LIEGE.

Sir Cecil Hertslet has written a very interesting report (No. 650, Miscellaneous Series) on the Arms industry of Liège, which holds, as it has held for centuries, a prominent place in the many great industries of Belgium. Liège has witnessed every change in the manufacture of fire-arms since their invention, but it was not until the evolution in fire-arms took place in the sixteenth century by the introduction of the flint lock that the industry began to assume the proportions of a regular trade. It was at the time of this invention that the Liège arms industry was seriously established, and came to be generally known by the title of the "Armurerie Liègeoise," which name it bears at the present day. The mode of manufacturing arms at Liège is of much interest in view of the unusual manner in which division of labour is carried out in practically all its branches. A large majority of workmen in the trade carry on their work at home, having private forges and workshops, and are engaged in one special branch of the trade, at which they become very skilful. These workmen initiate members of their families into their own particular branch, trying to give a perfect finish to their manufactures, and to discover and carry out new theories. The maker of barrels, for instance, is frequently engaged in manufacturing barrels for several different factories at the same time, and the better the work, and the higher the finish of the articles he produces, the more likelihood there is of his obtaining regular and lucrative employment. Thus the major part of the workers in the Liège arms industry are practically their own masters, the remuneration they receive for their work depending entirely upon their intelligence, ability, and application.

The arms industry of the Continent may be said to have had for many years past its centre at Liège. Each category of workmen has its own specialty. The collective knowledge of the construction of a firearm is only found at the Arms factories, and it is to the manufacturer that the credit for distribution of labour, that is to say, the art of gunmaking, should be given. The system has commenced to undergo a certain evolution, machinery coming into play in the manufacture of entire guns, and in the making of the many separate parts. In the production of barrels machinery takes a leading part as it also does in the manufacture of cast and stamped parts of iron and steel, such as breach pieces and revolver bodies. Up to the present time the two systems of working at home, and manufacture by machinery, have been carried on in conjunction with one another, and it is not anticipated that manual labour will ever be dispensed with as the result of the advantages of mechanical power. In point of value, says Sir Cecil Hertslet, the mechanically constructed article cannot compare with the hand-made gun, especially in regard to arms of particular finish. The fact that manual labour will always hold its own in the arms industry was recognised by the Union of manufacturers when it established the Liège School of Armoury for instructing young men intending to take up the trade.

Sir Cecil Hertslet describes the duties of the various persons employed in the principal arms factories at Liège. The *personnel* includes the following—the overseer, whose occupation is to distribute the work to the various bodies of workmen; controllers, who examine each piece when handed into the factory; and finishers, who put the final touches to the gun before it is ready for delivery to the purchaser. The manufacturer buys the barrels in their roughly-made state from the piece-worker, who makes them, and then hands them over to the fitter (also frequently a piece-worker) who welds the single barrels together; the barrels are then returned to the manufacturer and are passed on by him to the breach-fitter who fits the breaches and barrels together. The breach piece manufactured by machinery is furnished to the breach-fitter, who is required to properly fashion it before fitting it to the barrels. The pieces mechanically stamped out, which form the lock, are finished and put together by the lock maker. The lock is then attached to the barrels by another workman described at Liège as the "Systémeur," and by yet another worker is fitted with its stock. When all the various parts are in order, and fitted together, the guns are submitted to the finisher referred to above, who sees that they are properly adjusted. The guns are then submitted to the processes of nickeling, polishing, and engraving.

The introduction of machinery into the Liège arms industry has, in Sir Cecil Hertslet's opinion, been in every way a success. The manufacturers are pleased because it enables them to accept and carry out orders which, under the old system, they would have been obliged to refuse on account of the inability to deliver

the guns before in a specified time. The workers welcome machinery, because the continual placing of orders supplies them with a greater quantity of work which, as it is done on the piece system, ensures a corresponding regular rate of pay. Sir Cecil Hertslet is satisfied that machinery will never completely supersede manual labour at home in the arms industry, so far as Liège is concerned, and his opinion rests on the following reasons:—All pieces entirely manufactured by machinery must be, to a great extent, similar in pattern, and the Liège arms industry is famous for the diversity and originality of its productions. Every year, guns of a different model are manufactured, and the principal aim of the Liège manufacturers is to supply their travellers year by year with a collection of samples differing in many essential points from articles previously produced. The object of this is to create a demand for the Liège models on the part of dealers in other countries, and by this means to draw to Liège the most important orders.

In regard to the making of barrels iron is only used in the manufacture of damask steel. Siemens-Martin and Bessemer steel of all qualities are coming more and more into use in the making of forged and stamped out parts. The wooden mountings and stocks are principally made of walnut, which is purchased in blocks already rough-shaped. For revolvers, a considerable quantity of hardened caoutchouc is used, as well as celluloid, which can be made of any tint and shape required.

Of late, the manufacture of gun barrels entirely from steel has come into prominence, but those constructed of damask steel still retain their popularity notwithstanding the additional cost. Many guns are furnished with mechanically made steel barrels, and this latter branch of the industry has attained great importance at Liége.

COTTON GROWING IN ARGENTINA.

The cotton zone of Argentina lies chiefly north of the thirty-third parallel of south latitude, and comprises about 375,000 square miles, being greater in extent than all the Gulf States of the United States including Georgia and South Carolina, although not more than half of this territory is suitable for cotton growing, by reason of altitude and climate, yet there are at least 150,000 000 acres of cotton land, according to the American Consul-General at Buenos Aires, much of which under skilful management is said to be capable of producing excellent crops of cotton. In some localities insects are very destructive to the cotton plant. Cotton was grown in Argentina when the Spaniards first settled there. The Jesuit colonists in the province of Misiones, in the eighteenth century, exported cotton of good quality, but the growing of cotton in Argentina was discontinued when the establishment of steam navigation on its rivers, and the construction of railways brought foreign cotton products and undersold the native goods. A feeble and unsuccessful attempt was made to revive the growing of cotton during the American civil war as the supply from the United States was cut off. Argentine cotton is all of the short staple varieties, and the plants are perennial in some localities, living for more than twenty-five years. Numerous varieties of cotton from North America have been experimented with, and in most instances it has proved to be superior to the native seed. The temperature during eight or nine months of the year averages about 80° Fahrenheit during the day and about 70° during the night. The maximum in midday during the summer frequently reaches 105°. The chief rainfall is during the winter season, but every month of the year is well supplied with rain except the months of January and February in which there are sometimes droughts. Cotton may be planted as early as the 1st September. The plants will rarely cease to grow during the whole year, but in some seasons, as was the case in 1904, frost may kill the plants in the winter season. For the last six or seven years, cotton has been successfully grown for commercial purposes, and the area planted last year was over 15,000 acres. As the population in the cotton district is very much scattered, labour is comparatively difficult to obtain, except Indian labour. Indians, however, are found to be lazy and unreliable. The cost of picking cotton runs as high as three farthings a pound. Transportation charges are so high that they preclude the growing of cotton except along the navigable rivers. Some of the companies engaged in ginning cotton, extract the oil and make cake for exportation. The land in the Argentine cotton zone varies. Some is open, and can be prepared for tillage with but little labour, some is covered with a tangle of trees and vines, while other large portions are covered with water, from one to twenty-four inches. The open lands are level, free from stone, very fertile, and are easily tilled. The most available lands for cotton plantations are held chiefly in large tracts of 100,000 acres or more. These tracts sell from about eight shillings and fourpence to thirty-three shillings and fourpence per acre, and the smaller tracts of choice land sell at prices varying between twenty-one shillings and eighty-three shillings per acre, and are constantly advancing. The public roads through these districts are few, and very poor, and the streams are without bridges. Taxes are relatively high. These lands are useful for many purposes other than cotton growing. Cattle, sheep, and swine are bred there very successfully, but horses are not, because of the dangerous and contagious disease, called "mal de cadera," a malady that soon proves fatal. Potable water in some parts is difficult to obtain, but in others good and wholesome water is in abundance. All articles of consumption are very dear, except what is produced on the land, and while a great variety may be grown, it is practically worthless, except for home consumption, because the territory is so far from any market, the nearest being Buenos Aires, which is from 800 to 1,500 miles distant.

ARTS AND CRAFTS.

Arts and Crafts and Home Arts.—Akin to the arts and crafts movement, in its more restricted sense, is the work of the Home Arts and Industries Association, which has held an annual exhibition in London for more than twenty years. The two movements started, of course from quite opposite standpoints, and are not in any way directly connected. The Arts and Crafts Exhibition Society originated amongst designers who were anxious that their profession should be more generally recognised, while the aim of the Home Arts and Industries Association was to encourage the workman in the country districts. But, while the tendency of the arts and crafts movement has been to identify itself more and more closely with the cult of hand-work, and to encourage artists to execute their own designs throughout, the promoters of the Home Arts have shown a decided inclination to encourage the workman to make designs for his own work. If these two courses do not exactly meet at a common point, they at least show an inclination to converge. Putting theory aside, however, the artistic portion of the work exhibited every May by the Home Arts and Industries Association at the Albert-hall (the purely industrial portion does not, of course, come within the scope of these notes) is very much like a rural and somewhat amateur version of the simpler branches of work exhibited at the Arts and Crafts. The aim of the Association, as is pretty generally known, is to encourage the practice of handicrafts and to revive old crafts. The sphere of its operations is mainly in villages and country places out of reach of organised technical instruction. The classes held under its auspices are generally started by voluntary teachers and more or less backed, if not taught, by some influential person in the neighbourhood. The work is generally begun as a kind of recreative evening occupation, but it frequently develops into a by-employment for the students, and may even become the regular employment of a number of them, more especially of the girls, or of cripples and others physically unfit to earn their living in ordinary ways. It is this development of the movement which brings it out of the region of amateur work and leads us to consider it as something which in a measure, and in an ever-increasing measure, has a certain bearing and effect upon more organised industry. The work turned out at Yattendon, under the influence of Mrs. Waterhouse, at Compton under Mrs. Watts, at Keswick under Mrs. Rawnsley, as well as that from various other places, is now fairly well known, while several of the Haslemere weaving and embroidery businesses used to exhibit under the wing of the Association, and sundry firms show (on what plea it is difficult to imagine) their wares at its exhibitions. One of the most striking points in the show generally is the fidelity with which the work of the class as a whole reveals the taste or want of taste of the class-holder or the presiding genius of the place. Year after year good work or bad, as the case may be, will be exhibited by some particular class and then suddenly a change will come, and it proves, on inquiry, that the class has passed into new hands. This is hardly an argument in favour of the inborn artistic capacity of the workman. On the other hand, the work from Compton, Yattendon, and other places, does prove that with judicious guidance and direction, raw country lads can produce work which is fresher and more interesting, if somewhat ruder, than the ordinary trade stuff.

The Home Arts Exhibition.—The work from Compton at this year's exhibition, as for some years past, is mainly a kind of carved terra-cotta work quite unlike what is being done elsewhere or what any trained potter or modeller would think of doing. The font, which is the great feature of the exhibit, shows what a characteristic result comes of this unorthodox way of manipulating clay. Repoussé metalwork is always one of the most important crafts. The work of some of the old-established classes like Keswick and Yattendon is now technically far in advance of that done a few years back, and the dignity and simplicity of some of the design makes one wonder why the ordinary copper pots on sale in the shops are so trivial and eccentric. The trade might well in this respect take a lesson from the home arts. There is an exhibit from Wilton, near Salisbury, which includes a wooden chest, with wrought and polished iron fittings, executed by the local blacksmith, which shows how much might be done in a direction which has so far been comparatively neglected. It is surely better to encourage a trade which is already on the field, than to plant fresh trades of which the students are necessarily entirely ignorant. Nearly every village has its blacksmith, and if he could be taught to turn his great skill and knowledge of his material to simple artistic account, we might hope to see before long something better in the way of hinges, locks, handles, &c., than we usually meet with. Leatherwork has always been well represented at these exhibitions. That which comes from Leighton Buzzard and Porlock Weir has for some years been both technically and artistically interesting. These two classes have now turned their attention to lacquered leather. The work from Porlock Weir is pleasing in colour and design. In the more ambitious pieces from Leighton Buzzard, figure-work has been attempted, but the idea suggested by the arrangement of the work, of carved wood surrounding lacquered leather panels, is fresh and interesting. Wood-carving is another craft which is always a feature of the shows. There is now far less chip carving and other such elementary work shown than in earlier days, whilst some of the workmanship is excellent. Wood-inlay still holds its own. One could wish sometimes for greater technical perfection, but the colours are usually pleasant, and the passion for weird and somewhat ugly designs seems to be on the wane.

The lace exhibits have steadily grown and the work sent from Buckinghamshire, Norfolk and other places is good. It is curious, however, to note that Honiton patterns are being used in Norfolk, while a good deal of the lace made in Buckinghamshire is copied from the coarser kinds of lace made in the Venetian district. This work is done partly by girls, partly by married women in their spare time, but the prices which it is found possible to pay the workers make us realise that, should lacemaking ever be extensively revived among us, there will be danger of its ranking with the sweated industries. Needlework of all kinds is naturally well represented. One exhibit contained some beautiful smocking in which the characteristics of the old county smocks had been carefully retained and adapted to the children's smock frocks. It is to be hoped that still more counties will be represented next year. Alongside this most natural and traditional kind of embroidery is a great deal of work of a much more ambitious character, which though lacking in the historic interest of the smocking, in in its own way of decided interest. Amongst the many embroidery exhibits the work from Windermere is distinguished by the freshness and fearlessness of the colour as well as by the delicacy of the workmanship. The general trend of the exhibits, however, is in the direction of coarser work in which the maximum of effect is obtained with the minimum expenditure of time and labour. Two or three classes send well executed copies or adaptations of old English crewel patterns in greens, blues and browns on a white ground, and there are some large *portières* in *appliqué* which, though they have evidently been executed by rather inexpert fingers are coherent in design and effective in result and rather unlike what has been done before. Another industry which has come to the front is rug making, both on canvas and in the loom. This shows a distinct advance this year both in colour and design. Some canvas rugs made under the Brabazon scheme are quite Oriental in feeling, and from Ireland come some large rugs made in the loom, which demand attention both by their colour and design. Speaking generally it may be said that the work of the Association has passed the purely experimental stage and has reached a point at which it has an appreciable effect upon certain more or less artistic crafts and industries. This influence, representing as it does the work of educated people who are earnestly trying to cultivate the taste and intelligence of the country workman, cannot fail to be beneficial. If handwork is thus encouraged in country districts certain industries will, it is to be hoped, be saved from perishing, and others rescued from oblivion. Still, the fact that the movement is from above downwards—the revival by more or less outsiders of village crafts and not the spontaneous growth of those arts which survive in country places, introduces an element of artificiality and preciousness which if not carefully watched might lead it to develop on lines neither truly artistic nor practical. That thi tendency has been held in check is very much credit of the Association as a whole.

OBITUARY.

SIR CHARLES TENNANT, BART.—Sir Charles Tennant died on June 4th, at his residence, Broadoaks, Byfleet. He was the son of John Tennant, head of the St. Rollox Works, Glasgow, and was born on the 4th November, 1823. His grandfather was a Glasgow bleacher, who revolutionised his trade by the invention of a famous bleaching powder. He was trained in business at Liverpool, before joining his father in Glasgow. In 1866 he formed the Tharsis Copper Company, and in 1872 the Steel Company of Scotland. In 1890 the St. Rollox Works was transferred to the United Alkali Company, of which he was President. He possessed business qualities of a high order, which was proved by the great success of his various undertakings. A friend writing in *The Times* says of him—"He created in turn a fortune, a family, a country home (each unique in its own way), and collection of books, prints, china, and pictures which it would be difficult to rival." Sir Charles was elected a Member of the Society of Arts in 1880.

GENERAL NOTES.

GALVESTON'S SEA WALL.—Whilst the portion of the wall constructed by the county of Galveston as protection against the sea was finished in July, 1904, it was only recently that the part designed to protect the property of the Federal Government was completed under the United States Engineers' supervision. It is a continuation of the County Wall. Its total length is 4·37 miles, and it extends completely round the front of the town facing the Gulf of Mexico. The wall weighs 40,000 lbs. to the lineal foot, and is built of cement upon a round piling foundation, the piles being 45 feet long and not less than 12 inches at the top in diameter and 17 inches at the base. The piles are driven in four rows at intervals of four feet from centre to centre. The wall itself measures 16 feet at the base and five feet across at the top, and is 17 feet high. It is protected from the effects of undermining by the sea by an apron of rip-rap stone 27 feet wide, as well as a row of sheet piling driven to a depth of 24 feet in front of the entire length of the wall. It was, of course, found necessary to raise the level of the district of the town protected by the wall, especially the portion in proximity to it. So that, starting with a level of 17 feet at the wall, the grade is gradually to come

down to the normal at about half a mile, or a little more, from the gulf. By means of a canal excavated on the land side of the sea wall, says Mr. Consul Nugent, from whose report (No. 3585, Annual Series) we have been quoting, dredges containing sand pumped from the bottom of Galveston Bay are enabled to discharge their contents through pipes extending to the portion of the town to be raised. This huge enterprise is now a quarter completed, and is apparently successful. Some idea of the undertaking may be formed when it is stated that 2,156 buildings, mostly residences, have to be raised in the district to be filled. Some of these are large brick buildings, and yet such is the ingenuity of the Americans that the raising of such a house, three feet or perhaps six feet, is thought no great feat.

Wheat from America.—In his report on the trade of California for 1903, Mr. Consul-General Bennett predicted that within fifteen years the United States would not have a bushel of wheat to export owing to the whole crop being required for home consumption, and in his report for 1904 he predicted that within eight years no wheat at all which had been grown west of the Rocky Mountains would be available for export. Tables were given showing that the wheat exports from San Francisco to the United Kingdom had fallen from 1,000,000 to 166,000 centals in 1903, whilst exports of flour had dropped from 383,000 barrels to 36,000 barrels. In his report for 1905, just issued (3564 Annual Series) the Consul-General gives the figures for last year of exports to the United Kingdom as 159,000 centals of wheat and 591 barrels of flour. The total exports of wheat amounted only to 184,000 centals as against 3,600,000 centals for the previous year. The practically total collapse of the wheat exports from San Francisco has had its natural effect in the substantial diminution of British tonnage entering the port.

Sanitation and Malaria.—What can be done by sanitation to stamp out malaria is shown by Mr. Consul Morgan in his reference (No. 3565, Annual Series) to the work of the Italian Red Cross Society during late years to stamp out malaria in the Roman Campagna. The first attempt was made in 1900, when the returns showed that not less than 31 per cent. of the inhabitants of the "Agro Romano" had been fever-stricken. In 1901 the figure was returned at 26, 20 in 1902, 11 in 1903, 10 in 1904, and 5·1 during last year. These results were obtained by strict sanitary measures, use of wire nets so as to prevent access of mosquitoes to cottages, and free distribution of quinine among the peasantry. During the summer months a number of doctors belonging to the Red Cross Society take up their posts in the malarial districts in order to administer the necessary antidote as well as to show the people how to protect themselves from infection. The expenditure required for the effective operation of the organisation is partly paid out of the King's privy purse, and partly by the provincial and municipal authorities.

Automobiles, &c., in Finland.—Automobiles and motor boats have already made their way up to the far North, and it is expected that in the season now commencing the increase will be great. German, French, and American makers, says Mr. Consul Cooke, in his report on the trade of the Grand Duchy (No. 3575, Annual Series), prevail at present, British manufacturers being unrepresented. The bad roads are the great difficulty in the way of motorism in Finland, and they are not likely to be generally improved just now; but British manufacturers ought not to be unrepresented in the trade, such as it is. It may be noted that the direct butter trade with England continues to increase. The value of the whole butter export amounted to £1,521,880 in 1905, as against £1,094,760 in 1904, and most of it is shipped to the United Kingdom. But whereas ten years ago 42·3 per cent. of the butter went to the United Kingdom direct, and 40·7 per cent. to Denmark, of last year's export 71·6 per cent. went to the former, and 18·2 per cent. to the latter. The Finnish exporters are trying more and more to trade directly with the United Kingdom.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 11...Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Gerald Otley Case, "Submarine Groyning."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m. Annual meeting.

Tuesday, June 12. Alpine Club, 23, Savile-row, W., 8½ p.m.

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. Lionel Decle, "The Development of our British African Empire."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Sir George Watt, "Tea and the Tea Plant."

Wednesday, June 13...African Society, Criterion Restaurant, Piccadilly, W., 9 p.m. Mr. H. Gordon Hodgkinson, "Mining in West Africa."

British Archæological 37, Great Russell-street, W.C., 4½ p.m.

Geological, Burlington-house, W., 8 p.m. 1. Prof. William Johnson Sollas, "Recumbent Folds Produced as a Result of Flow." 2. Prof. Helgi Pjetursson, "The Crag of Iceland—an Interlacation in the Basalt-Formation."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

Victoria Institute (at the House of the Society of Arts), John-street, Adelphi, W.C., 4½ p.m. Mr. F. Enock, "The Wonders and Romance of Insect Life."

Thursday, June 14...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Art Workers' Guild, Whitefriars Glass Works, E.C., 8 p.m. Mr. Harry Powell, "Cut Glass."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Friday, June 15...Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

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FRIDAY, JUNE 15, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fifty-second Annual Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 27th June, at 4 p.m.

(By Order of the Council),

HENRY TRUEMAN WOOD,
Secretary.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The central portion of the gardens only will be used. The gardens will be illuminated with coloured lamps, and also by the Kitson incandescent oil light. The Conservatory and the Club-house will be open.

The reception, by Sir Owen Roberts, M.A., D.C.L., F.S.A., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broadwalk, from 9 to 10 p.m.

The Tropical-house, containing the giant water lily (Victoria Regia), and other interesting tropical plants, will be open to visitors.

An exhibition of growing and cut roses and other flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

A selection of music will be performed by the string band of the Royal Artillery in the Conservatory, and by the band of H.M. Scots Guards in the gardens, commencing at 9 o'clock.

Two performances of selections from pastoral plays will be given in the gardens by Mr. Patrick Kirwan's Idyllic Players at 9.30 and 10.30 p.m.

A concert and entertainment by members of Mr. Kirwan's company of Idyllic Players, with choruses by children (Bellew and Stock's choir), will be given in the Club-house at 9.45 and 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday evening, May 29th. The meeting was held at the Whitefriars Glass Works.

The paper read was—

CUT GLASS.

By Harry Powell.

The fear that the records of a craft, in which English and Irish workmen once excelled, may be totally lost, justifies an attempt to collect and piece together the scattered fragments. In recent years the craft of glass-cutting has been severely neglected, and it is hoped that this contribution to its history, brief and imperfect as it necessarily is, may help to restore to it some share of the interest which it once attracted.

Mr. Hartshorne, whose unfailing help I am glad to be able to acknowledge, has dealt with cut glass as applied to wine glasses in his great work on "Old English Drinking Glasses," and, Mr. Percy Bates, from a collector's point of view, has also treated the subject, but cut glass, as an English craft, has never received adequate and sympathetic treatment.

In the early Victorian period cut glass was exceedingly popular, but the craft, like most other artistic crafts, was also exceedingly debased. About the middle of the reign cut glass lost its popularity, and, although for some time past admirable specimens have been produced, it still remains the Cinderella of the artistic crafts. Other crafts have suffered a similar eclipse, but have regained popular favour and artistic recognition, but cut glass is, at the best, regarded with sufferance, and to the æsthetic soul is still a thing accursed. The continued æsthetic ban on cut glass is a striking testimony to the persistence of Ruskin's influence, and it is all the more remarkable if it can be proved that he denounced a craft without possessing adequate knowledge, and without sufficient consideration. In the twelfth appendix of the second volume of "The Stones of Venice," Ruskin writes as follows :—

"The workman has not done his duty and is not working on safe principles unless he so far honours his materials as to bring out their beauty and to recommend and exalt their peculiar qualities. He will invariably find the material grateful and that his work is all the nobler for being eulogistic of the substance of which it is made. But of all the arts the working of glass is that in which we ought to keep these principles most vigourously in mind. . . . . The peculiar qualities of glass are ductility when heated, and transparency when cold. In its employment for vessels we ought always to exhibit its ductility, and in its employment for windows its transparency. All work in glass is bad which does not, with loud voice, proclaim one or other of these qualities. Consequently all cut glass is barbarous, for the cutting conceals its ductility and confuses it with crystal."

An opportunity for estimating the justice of this denunciation will occur when, in the process of piecing together the history of cut glass, specimens are examined to illustrate the various stages of its development. Ruskin's low opinion of the artistic value of glass-cutting as a form of decoration may, or may not, be justified, but it has been a contributary cause of the neglect and dispersion of collections, which were formerly as highly valued as collections of china, and has increased the difficulty of the investigator.

The first step towards collecting material for this paper was the issue of a circular to persons and public bodies, in whose possession it was thought there might be specimens of eighteenth century cut glass. The replies to the circular from Ireland proved that Ruskin's influence had little influence in that country, and that Irish householders were proud of their collections of Irish cut glass. There has consequently been little difficulty in hearing of authenticated specimens of Belfast, Cork, and Waterford cut glass.

The English replies have been invariably kind, but almost invariably disappointing. The historic houses, with hardly an exception, possess no cut glass. Of the colleges of Cambridge, Clare possesses two cut glass cruets or vases, and of the colleges of Oxford, Christ Church possesses one cut glass mustard pot and one cut glass jug. But neither at Oxford or Cambridge is anything known about the history of the few pieces that remain.

Of twelve of the leading City companies, the Drapers' Company is the only one which acknowledges the possession of any old cut glass, and nothing is known about the origin of the three fine decanters which have been preserved. Even in the national and provincial museums cut glass is very inadequately represented. The British Museum has no eighteenth century cut glass, the Victoria and Albert Museum has a small collection, but the origin of no single piece can be authenticated. The

Guildhall Museum has no specimens. The Bristol Museum possesses a few pieces of old cut glass which are said to have been made and cut in Bristol. The museums of Bath, Birmingham, Burslem, Glasgow, Newcastle and Sheffield either have no specimens or, if they have, nothing is known about them. Such a result is truly disheartening especially if our poverty and lack of interest be compared with the keenness exhibited in such matters in Germany. In the comparatively small town of Reichenberg a complete historical collection of German glass has been secured, and a superbly illustrated catalogue has been issued.

The history of cut glass commences in Rome. It is supposed that the craft was derived from Egypt, although no specimens of Egyptian cut glass are known. The Romans certainly brought the craft to a high state of perfection, and no later craftsmen have so accurately gauged its limitations and its possibilities. Roman cut glass is well represented in the British Museum and in the museums of Cologne and Nuremberg. The specimens may have been executed by Greek workmen, but they were made to meet the demands of Romans, and they prove that Roman taste so far from being decadent and debased, was artistically true and refined. Glass-making in Rome was in a high state of development, and greater triumphs in glass-making were produced in Rome than in Venice in her best days.

Pliny, in book xxxvi. of his "Natural History," very accurately defines the process of glass-cutting. Speaking of glass-cutting as distinct from carving, he says, "Aliud torno teritur, aliud argenti modo coelatur," which may be thus freely translated; one kind of decoration is cut into the glass by means of a revolving wheel, the other is carved with a tool similar to a silversmith's graving tool.

Except for changes in detail, the modern process of cutting is identical with that described by Pliny in the middle of the first century. A wheel or disc of iron or stone or carborundum on a horizontal spindle is caused to revolve by the human foot, by water power, by steam, or by electricity. The wheel is fed with sand and water or water alone, the glass object is pressed by the workman against the edge of the wheel and a groove or mark is produced. The workmen, by moving the glass object whilst in contact with the wheel, can produce curves, and by combining lines and curves can produce patterns. After the patterns have been cut, the roughened surfaces are polished by pressing the glass against a wooden wheel fed with putty powder and water. The process sounds exceedingly simple but, in reality, requires skill of a very high order.

The Roman cutters seem to have had no immediate successors. The craft either died out altogether or passed from Rome to Constantinople. Chronologically the next form of cutting, which is known, is that applied to the strange deeply-cut tumbler shaped vessels, called Hedwig glasses. They are supposed to have been made and cut in Constantinople in the twelfth century. Only seven of these glasses are known and no specimen has found its way to this country. Their similarity leads to the belief that they were all cut by the same craftsman. They owe their preservation to the veneration with which they have been regarded.

After the taking of Constantinople by the Turks in 1453 there was a renaissance of glass cutting in Italy. The style differed from the old Roman cutting, the cutters having evidently been trained in the art of cutting rock crystal and gems.

At the end of the sixteenth century, Rudolph II. introduced Italian cutters from Milan to take control of the crystal and glass-cutting works he had established at Prague.

It was at Prague that Caspar Lehmann and Zachary Belzer learnt the craft. George Schwanhard, a pupil of Caspar Lehmann, introduced glass-cutting in Ratisbon, and about 1690 Stephen Schmidt and Herrmann Schwinger started as cutters and engravers of glass in Nuremburg. The craft was well and firmly established in Germany long before any attempt at glass-cutting was made in this country. To trace its origin in England it is necessary to go back to the year 1615, when King James I., in consequence of a petition for the preservation of the woods and forests, issued a proclamation absolutely forbidding the use of wood for melting glass. The result of the proclamation was the exodus of the glass-makers from the woodlands and their settlement in the neighbourhood of coal mines or in places on the seaside, or on navigable rivers, where coal could be readily and cheaply obtained. So long as the glass-makers were allowed to use wood for melting their glass they were able to use open crucibles, as is still the case in Murano, but when they were compelled to substitute coal for wood they were forced to cover their crucibles in order to protect the glass from contamination. The covering of the crucibles cut off a certain

amount of heat, and it was found that the same mixture, which fused and cleared itself readily in an open crucible, would not fuse and clear itself so quickly or so well in a closed one. All ordinary glasses are composed of definite mixtures of metallic with alkaline-metallic silicates. If the proportion of the latter be increased the glass becomes more fusible but is liable to deliquescence and decay; on the other hand, if the proportion of lime silicate be increased, the glass is rendered more infusible. The glass-makers were therefore in a position of considerable difficulty, as they found that the only known glass mixture that would melt in a covered crucible produced a glass which was not durable. After, doubtless, many fruitless experiments, it was found that by reducing the proportion of lime and adding a small quantity of litharge (oxide of lead), a glass was produced which was not only more fusible, but brighter and clearer than the old glass. At first the litharge was used in small quantities merely as a flux, but about the middle of the seventeenth century it was discovered that if the proportion of litharge was increased, the whole of the lime might be dispensed with, and that if carbonate of potash was substituted for carbonate of soda, an exceedingly brilliant and practically colourless glass was the result. Manufacturers in those days could not rely on the purity of their raw materials, and, although they strove, and often succeeded, in obtaining absolutely colourless glass, the glass was often tinted, owing to impure materials, and in some cases to the chemicals added to counteract impurities. The credit of the discovery of lead-potash glass, which is now known as English flint glass, is given to Thomas Tilson, a merchant of London, who, "knowing the glory and beauty of glass of lead, found means to increase the charge of lead." According to the Domestic State Papers of 1663, Tilson applied for and obtained a grant of the sole use and benefit of his invention of making crystal glass. This is one of the forgotten discoveries which should be commemorated, a discovery of which London may be proud. M. Peligot, a French authority on glass, and certainly unbiassed, has written as follows on the subject of "glass of lead":—"To the English should really be attributed the honour of having created in their flint glass a new product . . . . which is the most beautiful glassy substance we know."

Glass-cutting had been introduced into Germany in the eighteenth century, and in due course specimens of German cut glass found their way to this country. There is no proof that any glass was cut in this country before the beginning of the eighteenth century. At that time English glass workers had examples of German cut class to copy, and possessed a glass superior in quality to that of their masters. The superiority of English glass of lead to German glass lay not only in the purity of the metal but in its density. The power of breaking light up into its constituent colours is directly proportionate to the density of the translucent material through which the light passes. The density of glass of lead ranges from 3·2 to 4·0; the density of German glass is about 2·5; that of rock crystal is 2·6, and that of the diamond is about 3·5. The density of glass of lead approaches and in some cases exceeds that of the diamond, and it rivals the diamond in the production of prismatic displays. To this property has been due both the pre-eminence and decadence of English cut glass.

In 1713 English cut glass began to appear on the Continent. In 1760, on the authority of a French writer, England practically supplied the whole of France with glass. M. Gerspach, in his "History of the Art of Glass-making," which is mainly devoted to a description of glass-making in France, writes as follows:—

"The English glass which entered into competition with the Bohemian glass, in the middle of the eighteenth century, dealt a deadly blow to Bohemian colourless glass. The English material lent itself to facet-cutting infinitely better than the Bohemian, and beat the Bohemian glass, as that had beaten Venetian glass. It became the rage in all the continental cities and eclipsed the Bohemian cut glass."

It is doubtful if any other English craft has obtained such a testimony from a rival nation, and it is strange that so few records remain in England of a craft which, abroad, obtained such ample acknowledgement. So strong a testimony to its preeminence justifies an attempt to discover where the cut glass of the eigthteenth century was produced, and to recall the styles of work which the glass-cutters successively adopted.

The earliest specimen of English cut glass in Mr. Hartshorne's collection, the date of which can be approximately fixed, is a thistle-shaped glass, bearing the monogram of Frederic, Prince of Wales, father of George III. Frederic became Prince of Wales in 1729 and died in 1751. The records of English cut glass

may, therefore, be said to commence in the first half of the eighteenth century. The best period is between 1750 and 1790, and its decadence began in the early years of the nineteenth century. Thanks to Mr. Hartshorne a useful and suggestive succession list has been formed, based on the shapes and cutting of the bowls and stems of wine glasses. As similar cutting occurs on other objects this list can, to a certain extent, be applied to English cut glass generally. At the head of the list he places glasses with thistle-shaped bowls. This shape was copied directly from a Bohemian model, although at the present day Scotch glass-makers claim it as a special invention of their own. The thistle-shaped bowl was soon superseded in England by a straight-sided tumbler-shaped bowl. The stems were straight and cut with facets, the termination of the facets at the base of the bowl being crowned by deeply cut three-leaved sprays. Some large punch glasses of this character are preserved at Field-house, Sowerby, the property of the Stansfeld family. The glasses are engraved with an inscription commemorating the passing of the Calder and Hebble Navigation Act in 1758. It is supposed that the Stansfeld glasses were made and cut in Newcastle. The straight stems were succeeded by hexagonal knopped stems, the top facets being still crowned with three-leaved sprays. In later glasses of the same group the cresting is moved more than half-way up the bowl. At the end of the century the facets developed into long flutes, the cresting disappeared, and the tumbler-shaped bowls lapsed into the tapered or semi-tapered bowls of the wine glasses of our grandfathers. Cut glasses, with heavy squared feet, came into existence in the early years of the last century.

There is a common belief that certain styles of cutting indicate certain dates. It is true that a certain style may indicate that a glass was not made before a certain date, but a style, once introduced, was constantly copied, and the copying is still continued. Copying may be legitimate or illegitimate. The latter process is known as "faking." Some faked glasses are self-evident, but a glass may be so scientifically faked that its discovery is exceedingly difficult. The workmanship, the weight, the colour, the feel, the ring, and the wear of a glass are signs, but are signs which can be imitated. The only glasses about which one can be perfectly sure are those which have been handed down as heir-looms, and those about which an accurate record in writing has been preserved.

Mr. Hartshorne's succession list, suggestive as it is, is more useful to the collector than to the craftsman. A chronological table is needed, applicable to all forms of cut glass, and based on the relation of cutting to form. It might be divided into three periods; the first containing the glasses in which cutting is subservient to form; the second that in which the claims of form and cutting are equally balanced; and the third that in which cutting is the predominant partner. The first period dates from the abandonment of German models, the cutting of which was based on rock-crystal cutting, and lasted to about 1790; the second period lasted till about 1810, and the third period has not yet terminated.

English cutters were led astray by the softness and the refractive power of their glass. They found that as they cut deeper they obtained greater prismatic effects, and at the same time, greater profits from a dazzled and fascinated public. Deeper cutting necessitated thicker glass, and the triumphs of the third period are objects of great solidity, which bristle with prismatic pyramids like infuriated hedghogs.

The centres of glass-cutting in the eighteenth century were Belfast, Birmingham, Bristol, Cork, Dublin, Glasgow, Newcastle, Waterford, Stourbridge, Whittington (near Chesterfield), and London. Isaac Hawkes was established as a glass cutter in Birmingham in 1777. In 1785 large flint glass works were built at Temple Gate, Bristol, and were known as the Phœnix Works. In 1789 the owner's name was Ricketts. No definite information has been obtained about the works in Glasgow, Newcastle, and Stourbridge. Mr. Hartshorne gives extracts from invoices for table glass from John Dixon, of the Whittington Glass-house, near Chesterfield, to J. Sitwell, Esq. The invoices range from 1791-1793. They are, amongst other things, for "neat, Rodney, cut-neck decanters," for finger-cups with cut bottoms, and for a cut "shandilere." Glass-cutting was well established in Ireland before the end of the eighteenth century. There were glass works of considerable importance in Belfast, Cork, Dublin, and Waterford, and large quantities of glass were exported to America. The manufacture prospered in spite of the Union, its prosperity being mainly due to immunity from excise. An excise tax was introduced in 1825, and from that year the glass trade began to languish,

being burdened with arbitrary and vexatious restrictions. The Waterford Works survived the longest, but were closed in 1851.

The name of Edwards is connected with Ballymacarrett Works, Belfast. Engravers, as well as cutters, were employed. An advertisement for cutters appeared in a newsletter of 1787. Some of the Belfast glass has a peculiar milky opalescence.

John T. Maguire, writing in 1853 on "the industrial movement in Ireland," states that in 1825 there were still two glass houses in Cork held respectively by Messrs. Foley and O'Connell, and by the Ronayne Brothers. Glass-cutting was carried on at both. Mr. Maguire adds that within his memory the glass-blowers and glass cutters took the foremost part in all public demonstrations. Mr. Robert Day, of Myrtle Hill-house, says that the glass-works in Cork were in full swing from 1780 to 1820. He possesses a cut glass salad bowl, which was bought at one of the Cork glass works. The pointed pyramidal nailheads are considered to be a peculiarity of Cork cut glass.

The famous Waterford Works were established by a member of the Penrose family. The site of the works is now occupied by Dennehy's wrapper factory. In 1884 the works were in the hands of Messrs. Gatchell. The chief products of the Waterford Works were chandeliers, candelabra, salad bowls, jugs, decanters, and drinking glasses. There is a fine chandelier in the Waterford Council Chamber which was put up in 1802. Two deeply cut water jugs, in the possession of Mrs. Mollan, of the Haven, Howth-road, were bought at the Waterford Works, by her great grandfather, the Rev. Charles Tuckey. A slight bluish tinge in the metal, and flat nail heads cut with a cross, are peculiarities of Waterford cut glass.

The demand for cut glass would naturally be l.rgest in London, and there is reason to believe that in the eighteenth century London was the most important centre of glass-making and glass-cutting. In the list of streets in the London Directory of 1793 there are no less than fifteen Glass-house yards and one Glass-house alley. Six of these names survive in the London Directory of 1906, but only one glass-house. Although all members of the Glass-sellers' Company are not necessarily connected with the trade, the prosperity of the company in the eighteenth century suggests that the trade itself also prospered. In the London Directory of 1753 two important glass-houses are mentioned, one at the Falcon-stairs, Southwark, belonging to Mr. Jackson, "glassman," which afterwards became identified with the name of Pellatt, and the other, on the other side of the river, occupying part of the site of the house of the White Friars, and owned by Anthony Seale. Anthony Seale was succeeded by Carey Stafford, and Carey Stafford was succeeded in 1778 by Hall and Holmes. The Directory of 1771 gives the name William Parker, glass-seller, 69, Fleet-street. In 1784 the title of this shop was William Parker and Sons, glass manufacturers to H.R.H. the Prince of Wales. The ledgers of Messrs. Hall and Holmes, which are still extant, prove that very considerable business transactions were carried on between the glass works of Hall and Holmes and the neighbouring glass shop at 69, Fleet-street. Mr. F. A. Newdegate, of Arbury, Nuneaton, possesses two excetdingly fine eighteenth century chandeliers, as well as other glass of the same character. On looking over some old papers he discovered not only the bill for a chandelier supplied by Messrs. Perry and Parker, of 69, Fleet-street, in 1804, but letters and copies of letters concerning the whole transaction. There is a copy of a letter from Sir Roger Newdegate enquiring the price of a chandelier similar in design to two eight-light lustres, supplied in 1788, but to be for twelve lights. There is also a letter in reply from Perry and Parker, dated October 17th, 1804, saying that they have in their drawing-book a sketch of the lustres sent in 1788, but they recommend that the branches of the new chandelier be cut plain, as "plain arms have succeeded those cut with hollows, and are more generally approved." The large twelve-light chandelier at Arbury is probably, for metal and design, one of the finest in England. Works capable of producing a masterpiece of this description must have been in a high state of efficiency, and on whichever side of the Thames it may have been produced, credit for its manufacture must be given to London. Ruskin has said that "cutting obliterates the ductility of glass," but no form of manufactured glass can more forcibly proclaim ductility than the long sweeping arms of this magnificent chandelier.

The study of the development of the craft of glass-cutting shows that the object has been to give expression to one of the essential qualities of glass, namely, its inherent brilliancy. That this quality should always be coyly hidden under an unbroken surface seems to be a wanton waste of decora-

tive effect. An æsthetic edict against cutting as a method of decoration is as reasonable as a sumptuary law against wearing diamonds. Excess in the use of diamonds is as barbarous as excess in the use of cutting, but, when used in moderation, both are legitimate forms of decoration.

If to Ruskin's essential qualities of glass the quality of brilliancy be added, and if ductility be understood, not merely as extensibility but as the property which renders glass sensitive to the glass-blower's breath, a law may be formulated for the right treatment of cutting. Cutting applied in such a way as to proclaim the brilliancy of glass, without obscuring or cloaking the form, given by the glass-blower's breath, helps to illustrate an essential quality of the material, and can no longer be regarded as barbarous.

The cutting which most closely corresponds with the spirit of the new law is that of the Romans. Their system of lightly breaking the surface to dispel monotony and obtain flecks of brilliancy is the system from which cutters of modern table glass should draw their inspiration.

Before closing this paper it is impossible to refrain from an appeal in defence of so-called, barbarous cutting, provided it is genuinely barbarous. There is a fascination attaching to decoration cut into the implements, and sometimes into the flesh of primitive races. Cutting on glass, which is spontaneous, which asserts the workman's triumph in his absolute command over his tool and his material, which is deep rugged and savage, whatever professors of art and æstheticism may say to the contrary, appeals to something in our inmost nature, a survival, possibly, of our primitive brutality.

DISCUSSION.

Mr. LEWIS DAY, in proposing a hearty vote of thanks to the author said he was sure when the members realised how little was known of glass cutting and its history they would agree with him that Mr. Powell had, in spite of his apology, told them a great deal, and they would all go away knowing much more about cut glass than before. The author had shown them upon the screen some most interesting specimens of cut glass, not the least interesting of which were those to which Mr. Powell modestly referred as copies of old specimens, but which all present knew were made by Mr. Powell's firm, and some of which they had had the pleasure of seeing on their way to the lecture room. Before the audience proceeded to inspect the actual processes of glass-cutting and glass-blowing in the works downstairs, he was sure they would desire to thank Mr. Powell very heartily for the entertainment he had provided for them.

The vote of thanks was carried unanimously.

Mr. POWELL, in reply, said he was exceedingly obliged to Mr. Day for the kind words he had spoken. The collecting of the fragments of the history of cut glass had been a very pleasant work, and he wished his labours had been more complete. In the course of time he sincerely hoped that a really complete history of English cut glass would be made, and one of his great objects in writing the paper was for the purpose of appealing to the members of the Society of Arts if they came across authentic accounts of old English cut glass to kindly communicate with him. It seemed strange that so very few records should exist of a manufacture in which English craftsmen were absolutely supreme for a short time. From 1750 to 1790 there was no glass in the world that approached in quality to English cut glass, and it was therefore an extraordinary fact that there were so few specimens and records in the great museums of the country of that class of work.

MONTSERRAT.

Sir Daniel Morris has sent to the Colonial Office a very interesting report (Cd. 2877) from Dr. Francis Watts, Government Analytical Chemist and Superintendent of Agriculture in the Leeward Islands, on the condition of the agricultural industries of Montserrat, and the manner in which the further work of the Imperial Department of Agriculture might be directed to their assistance to the best advantage.

For many years Montserrat has struggled to maintain sugar cultivation, but gradually it has been abandoned, until in 1904 the exports of sugar amounted in value to only £3,656. Nor is it likely that the industry will recover any portion of its lost prosperity. Capital cannot be attracted to equip the estates with modern machinery, and whilst a good deal of sugar may still be produced, it must be of the common Muscavado kind, grown and manufactured by the peasants on a share system.

Under the auspices of the Imperial Department of Agriculture, cotton-growing has become an important industry in the island. The value of the cotton exported in 1903, the first year for which the returns are given, was £14,860. In 1904 it fell to £13 080, although the cultivation was larger than in the previous year, the diminution being due to diseases and pests, largely leaf blister mite, a new disease at that time not understood. This disease is now capable of control, so that in 1905 the cotton exported rose to £14,144, and it is expected that this amount

will be greatly exceeded this year. Cotton is, however, at present only grown by two or three large landowners. It is an industry requiring more skill and attention than sugar, skill and attention which the peasant has not learned to bestow.

The export of drugs is of some importance, and it consists almost entirely of papain, or the dried milk of the papain tree. This industry is one which has played a most useful part during the economic changes which have taken place in the island. It has provided the means whereby the peasantry have been able to earn small sums of money, which in the aggregate have been considerable. The milky juice (*latex*) which exudes from the fruit when the skin is scored or scraped is collected by the peasantry and purchased by those who dry and ship the drug.

Prior to the disastrous hurricane of 1899 attempts were being made to establish cacao. Most of the trees were destroyed by the hurricane, and in many cases the owners were too discouraged to endeavour to restore them, but patches of land are now being planted, and Dr. Watts is hopeful that in course of time a profitable industry will be created, as has already been done in Trinidad, Grenada, and neighbouring islands.

Rubber too can be successfully grown in the island, and there are now in Montserrat a few trees of Central American rubber (*Castilloa elastica*). Dr. Watts thinks that the Department of Agriculture, by a steady effort, can ensure the planting of a considerable number of these trees within the next few years. This, while having little immediate effect, may be of great importance to Montserrat in the course of time.

The island owes much to the assistance given to it by the Department of Agriculture for the West Indies. This department maintains in the island three experiment stations under the charge of a curator; in addition, it has provided for periodical visits by Dr. Watts and other officers, and it has furnished the means of lectures to teachers attending elementary schools, and for prizes at the annual agricultural shows that have been held in the island.

CHAMPAGNE MAKING IN FRANCE.

The great caves, or cellars, of such houses as Pommery, Mumm, Moet and Chandon, Krug, Ruinart, Roederer, Clicquot, Piper Hiedsieck, and others, are miles in extent, dug out of the solid chalk, from twenty to one hundred feet underground, one under another, without any supports for the most part. It is underground in these caves that the champagne is made, and where it is kept after the grapes are pressed, for from three to five years before it can be shipped to the dealers. The caves are completely lighted by electricity. Six of the large firms have caves that are eight to eleven miles in extent each. These caves are in reality subterranean passages that almost rival the catacombs of Rome in extent. According to the United States Consul at Rheims, they are much greater in the number of miles than the subways or underground railways of New York and London combined. The champagne caves of Rheims and vicinity are estimated to be fully one hundred and fifty miles in extent. The site on which Rheims is placed, in the business portion at least, is completely honeycombed underneath with tunnelled caves. The great caves of some of the large firms are in the environs of Rheims. Summer and winter they are kept at an even temperature—about 45 degrees Fahrenheit. One of the leading champagne houses has short cellars extending two or three hundred feet, in both directions, from the main tunnel, divided into geographical divisions representing the different nations of the world, the names in each case being indicated by large enamel letters. The champagne workman is generally of a superior type to the factory hand, as much skilled labour is required. Wages run as high as £12 per month, besides a bonus. In adopting the bonus system, to be paid only on condition of loyal and faithful service at the end of each year, the champagne houses have effectively cured the strike evil. Cleanliness, order, and sobriety are strictly enforced on the part of the persons employed. No chemists or scientific men are necessary, no foreign matter being employed in making champagne. The "chef de caves" alone tastes and blends the wine in the requisite proportions. It requires about four and a-half pounds of grapes to make one quart of champagne. The makers often pay as much as tenpence a pound for the grapes, while the ordinary table grapes sell in the market at less than one-fourth that price. The champagne grape is not used as a table grape. The latter is not grown in the Rheims district, but shipped from other parts of France and from foreign countries. In fact it may be said that nothing but champagne grapes are grown in the champagne district. The champagne grape is small and exceptionally sweet, hence its special qualities for creating a natural, sparkling wine. It is not white (as many people think), but black. A white grape is used to a limited extent, however, by certain manufacturers. Some of the great champagne houses grow their own grapes in part, but most manufacturers buy them. The vines can be divided into three divisions: — The Rheims mountains, with the famous plantations of Verzy, Verzenay, Sillery, Mailly, Rilly, and others; Bouzy, Ambonnay, &c., and the famous hill-sides of Avizet, Le Mesnil, Oger, Grauves, and Cuis, all south of Epernay; lastly, the valley of the Marne, with Ay, Mareuil, Champillon, Hautvillers, Piery, Dizy, Epernay, and Cumières. In these vineyards 25,000 vine dressers are employed. The cultivation of the champagne grape requires exceedingly refined processes, which to a great extent complicate and render the work very expensive. The cultivation (including fertilizer) costs from £30 to £60 per acre each year. While the production of grapes varies somewhat from year

to year, the soil of the champagne district produces an average of nearly £4,000,000 worth each year. Everything for the production of the wine and placing it on the market, except the cork, is furnished on the spot; and many of the grape growers, as well as the wine makers, bottle manufacturers, and cork dealers, have become very wealthy. The champagne bottle of the present day, in strength and endurance, is the result of the development of many years. Owing to the loss of some of the elements in the glass, a bottle cannot be used the second time for champagne. The manufacturers of the cheap and artificially-charged wines use the secondhand bottles almost exclusively. The quart bottles, including the cork and fastener, cost from ninepence to elevenpence each, and the pint bottle sixpence to eightpence each when bought in large quantities, as the great Rheims houses must purchase them. The larger sized corks, which for champagne bottles must be the highest grade known, cost from 2d. to $2\frac{1}{2}$d. for each cork. The corks for pint bottles cost from $1\frac{1}{2}$d. to $1\frac{3}{4}$d. each. All corks for champagne bottles must be carefully selected. Every imperfect one is thrown aside for use outside the champagne trade. There are scores of cork experts employed by the large houses among the fifty cork manufacturers and dealers at Rheims, using materials that come from Spain and Portugal almost entirely. The champagne soil consists generally of a mixture of argillite, or clay, chalk and sand. The thickness of the upper or top soil varies from two to three feet. The undersoil in certain parts is of a clayey and calcareous nature, mostly the latter, which is nearly pure chalk in many places. The latter has a depth of from 250 to 500 feet, and in some places exceeding 500 feet. The vine adapts itself readily to the calcareous slopes, its roots absorb the fertilising elements which, owing to the permeability of the soil, filters through the fissures of the chalk. On those slopes of a chalky composition, the grapes grown produce a wine of a very superior character to that produced from grapes grown on the more clayey slopes. On the former, maturity comes earlier, the upper soil of very little depth, permeable, and very light, dries rapidly after a rain, the undersoil helping in that the water filters through very easily, permitting the sun's rays to heat the roots of the vines. The champagne vineyards are at the limit of the climate where it is possible to cultivate the vine in the open air. Champagne derives its name from the ancient province of Champagne, now a part of the north-eastern district of France. The fame of the wine has caused it to be imitated by the use of grapes grown in other parts of France, and in other countries. It is forbidden by law to use the name "champagne" on any wine made from grapes grown in France or elsewhere outside the area prescribed in the immediate vicinity of Rheims, consisting of about 45,000 acres. A proposed law, more stringent than any heretofore enacted, has recently passed the Chamber of Deputies. This law defines more definitely than ever before the area within which grapes from which champagne may be made can be grown. The owner of the vineyards a half-mile beyond the line cannot have his grapes made into wine, to be called "champagne." Under the law of March 21, 1884, many convictions have been secured. Merchants using the materials coming from outside the district and selling the product as champagne have been heavily fined. An action was brought in Rheims some time ago against a firm of wine merchants, and these were convicted of fraudulently using the name "champagne," fined £400 and costs, and assessed for the payment of an advertisement of the conviction in twenty newspapers, and the printing and placing in conspicuous positions of 1,000 posters giving publicity to the fraud. As a rule, the general public has a false and erroneous notion as to how "sparkling champagne" is made. Grapes are never trodden by the feet, but are crushed with machinery by means of presses built on scientific principles. The "must" is at once separated from the stalk and skin which contain the colouring matter, and a liquid hardly tainted is obtained. After the first fermentation it becomes perfectly white. It is difficult to form an exact idea of the care which is exercised in gathering the grapes. The bunches are carefully detached one by one without any pressure, sorted according to their degree of ripeness, every berry generally well examined, the grapes being crushed every day without delay under the vine-press. The liquid obtained from the press after three consecutive pressings gives the "brew." It is this wine which has the necessary qualities to make sparkling wine. Those obtained by subsequent pressings are called *vins de suite* (after wines). Very inferior in quality, they cannot be used for choice champagne. As the must runs out of the press, it is placed in open tubs, where it is left to settle for twelve hours so as to allow the solid parts it contains to descend to the bottom of the tub. It is afterwards drawn off into casks that have been scrupulously examined; this is called the "clearing out." Fermentatiou begins a few days later, and changes the sweet liquid, or must, obtained by means of pressing, into an alcoholic and acidulated liquor which takes the name of "wine." As soon as cold weather sets in the wine becomes perfectly clear, when it is again drawn oft with the greatest care so as to separate it from the wine-dregs which have formed at the bottom of the barrel. During the two months of January and February, the merchant mixes in immense casks the wines of different vineyards, as experience has shown that in order to obtain wines uniting quality, bouquet, and daintiness the champage maker must mix different wines which possess separately and individually each of those elements. It is in the mixing that the wine dealer shows his knowledge guided by experience, as he must base his judgment on the quality of the wine at each vintage and on the characteristics of each vineyard. Generally wines put in reserve from previous years are mixed with those of the new vintage. It is owing to this that new wine is often improved,

the type of former vintages kept up, and the change is rendered imperceptible to the consumer. As soon as spring sets in bottling is proceeded with. The bottles are rinsed with minute care, filled up and hermetically corked by means of special tools. The first industrial attempts at bottling champagne which were not so very successful date as far back as the year 1746. The breaking of bottles was considerable. The most experienced men of that time had no idea of the way in which the sparkling was produced and they contented themselves with tasting in order to know whether the wine contained enough or too much sugar at the time of bottling. In 1836, however, a distinguished chemist of Chalons-sur-Marne succeeded after numerous experiments in determining the exact quantity of sugar which champagne must contain when being bottled in order to produce a fine sparkle. For this purpose he used the gluco-œnometer and took a given quantity of wine the alcohol of which had evaporated. By means of the gluco-œnometer the exact quantity of natural sugar contained in the wine is calculated before bottling. If this proportion is too small the necessary quantity of pure candied sugar is added; then the wine is bottled. The raising of the temperature on the one hand, and on the other the natural evolution of the ferments which take place at the same time as vegetation begins in vines, cause an active fermentation, thus transforming naturally the original sugar, or that which has been added, into alcohol and carbonic acid gas. In consequence of hermetic corking it remains in the shape of a dissolution in the liquid, and forms the sparkle. At that period, the wine is said to be "raw." "Raw champagne" is good only when it comes from particularly good vintages, or again, when it is kept for a good many years. The fermentation which has developed sparkle, has given rise to dregs that must be removed. As soon, therefore, as the wine has remained long enough in the cellar to be almost matured, the bottles are laid on their necks, that is upside down in a desk or table pierced with holes, and having an inclination of 60 degrees. Every day, for six or eight weeks, these bottles are gently shaken, that is, they are turned round with the hand by a sharp and quick circular movement. Gradually the dregs are displaced, and come down on the cork. The dregs that have formed in the wine, having accumulated on the corks, the liquor has become absolutely limpid. The workman takes the bottle with his left hand, keeping it inclined, cork downward, while with his right hand, by means of a hook, he cuts the wire which fastens the cork. Drawn with pincers, and blown out by the gas, the cork comes out carrying with it the dregs. By fermenting in the bottle, the wine has lost almost the whole of its natural sugar, and has thus become quite dry (*brut*). To remedy this, a certain quantity of a liqueur is added to each bottle. This being done, the bottle is corked again with a new cork of a superior quality to prevent the loss of gas. The cork which has been previously stamped by burning with the name of the firm, is made fast—sometimes with string, sometimes with wire—according to the merchant's taste. When the bottle has its label, &c., it is wrapped up in paper, then in straw, and placed in cases of baskets of various sizes. From first to last a bottle of champagne has passed through the hands of forty-five workmen.

TURKISH MARKETS FOR TEXTILES.

The value of the total annual imports of calicoes, prints, and various other cotton textiles into the Asiatic provinces of the Turkish Empire now exceeds £4,000,000. Smyrna and the adjacent territory absorb nearly one quarter of this trade. The weight of the annual importations of cotton goods into the port of Smyrna is over 6,000 tons. The United Kingdom has almost a monopoly of muslins, mulls, printed and coloured handkerchiefs, and supplies most of the calicoes and white goods (bleached and unbleached). Italy contributes much unbleached cotton. Drills come chiefly from Italy, the United Kingdom and France. Heavy cotton cloth is supplied mostly by Germany and Austria, with a certain amount lately from Greece. Italy is rapidly superseding this country in supplying cottonades, flannels and flannelettes. Cotton velvet comes from the United Kingdom and Germany. Cotton shawls are supplied by Germany and Austria. America contributes little to the trade, except the standard gray sheetings, the "cabot," which the American Consul at Smyrina says, are much appreciated throughout the East, and in certain distributing points in the interior occupy a predominant place in the market. The city of Koniah for example, is said to require annually 20,000 pieces of "cabot." A good indication of the needs of a fairly prosperous community is afforded by the trade of the island of Mytilene. The annual importation of foreign cotton goods there is valued at £16,000. It includes 2,600 pieces of drills (black and white), 2,050 pieces of gray shirtings, 1,800 pieces of modapollam shirtings (bleached and unbleached), and 1,000 pieces of "cabot." In the case of ginghams and the various other light cottonades there is a steadily increasing local production in the country itself, which, however, fails to gain on the growing demand. The trade in these articles in Smyrna amounts to about £100,000 per annum. Italy is at present the chief country to supply the needs of the market, then follow in order Switzerland, France, Germany, Austria, and the United Kingdom. In calicoes and prints, Italy leads in sales, absorbing 55 per cent. of the trade; the United Kingdom holds 35 per cent., and the European countries, 10 per cent. Germany is now devoting special attention to the preparation of designs which meet the public taste, and promises soon to gain a strong foothold in the market. This matter of design is all

important. Oriental races are accustomed to certain conventional styles of figure and colouring, which they are with difficulty led to abandon in favour of the current designs of western printers. Any measurable success in securing this class of trade, must depend upon a genuine effort to conform to the local canons of taste. Some of the leading firms in Smyrna which cater for this trade have branch offices in Manchester, where their representatives closely supervise the printing of the wares destined for this market. Italian manufacturers send their own agents to study on the spot the current demands, which do not, however, change rapidly from one year to another. There is a keen competition between the calico printers of the two countries, and the growing predominance of Italy is largely due to the exceedingly intelligent and untiring effort to meet prevalent needs and taste.

STERILISED MILK IN FRANCE.

In his report on the trade and commerce of Havre just issued (No. 3586, Annual Series), Mr. Consul-General Hearn gives some interesting particulars with respect to the work being done in France by the societies called "Oeuvres de la goutte de Lait," established for the distribution of sterilised milk to infants. One of the causes of the enormous mortality among infants in densely-crowded towns is the carelessness of mothers in nursing and feeding their babies, and these societies are doing great good in teaching the poorer classes the necessity and blessings of cleanliness, and in impressing upon mothers the great advantage of breast feeding as compared with hand feeding. According to British statistics it has been shown that in some large towns the mortality during the first year of life among breast-fed infants was only about one-third of that among hand-fed children. It is now well recognised that the heavy infantile mortality is due to ignorance on the part of mothers as to the danger incurred by injudicious feeding.

The first object of these societies is to give mothers advice and encouragement as to the proper feeding of their children at the breast, and when they are not able to feed them themselves to provide milk properly sterilised and prepared for feeding them by hand, in proper quantities for each child's requirements. All classes of children may have their milk from the societies, but the chief object is to provide for the children of the poorer workpeople, with whom the difficulty of bringing up children is the greatest.

The children are divided into three classes. The first includes those of the necessitous poor, to whom the milk is given for a daily payment of 1d. The second section includes children belonging to the well-to-do working classes, the milk being supplied to them for a daily payment of 3d. The third section includes the children of the richer classes, the milk being delivered to them for a daily payment of 7½d. All children, to whatever section they belong, receive the same quality of milk, prepared in the same way, and distributed in identical utensils. Each child has a duplicate set of baskets and bottles assigned to it, and registered in its name.

Each mother who brings up her children by hand receives every day during a year, or for longer if necessary, a basket containing as many bottles as the number of meals the child takes in the twenty-four hours. These bottles contain milk in quantity and strength proportionate to the age of the child. Every week, if possible, and in any case each month, the children are weighed, and their weights registered, so that the progress may be noted and the treatment regulated accordingly. The work is carried on by means of annual subscriptions, donations, sale of milk, and subventions from the State, the Department, or the municipality.

The first of these societies was founded at Fécamp in the Havre district, in the year 1894, and now there is hardly a town in Normandy that has not one or more "Goutte de Lait" societies. There are, at present, three at Havre, and they feed, on the average, nearly 400 infants daily. While the mortality among infants under one year ranges from 12 to 14 per cent. from enteritis, the mortality from the same cause, among infants brought up under the auspices of these societies, is not above 2 or 3 per cent. What scope there is in the world for the expansion of this work will be understood when it is stated, on good authority, that more than 3,000,000 infants are annually killed by ignorant or careless parents feeding them on impure milk, and administering to them patent soothing syrups and quack nostrums.

ITALIAN ANTIQUES.

The American Consul at Messina has recently reported upon the regulations of the Italian Customs authorities affecting antiques, which are of special interest to tourists in Italy. According to the regulations now in force all goods coming from Taormina in Sicily, for shipment to any foreign port, upon arrival at the Italian custom-house in Messina must be sent at the shippers' expense to the museum either at Palermo or Syracuse for examination by experts to discover if the cases contain any antiques. The declaration that they do not contain such articles carries no weight whatever. If an antique is found which comes under the law forbidding its exportation it is seized. If it is of a class that can be exported by payment of an export duty it is released when that requirement is complied with. If, however, this article be found in a package which was entered for exportation upon a declaration stating that no antiques were contained therein the shipper is subject to a fine which may amount to as much as £30. The Consul quotes a case in point in which an artist who had

lived at Taormina and who on his departure packed all his belongings and sent them to Messina for shipment. He declared the contents as household effects. When examined there were found numerous antiques of Italian origin but of little value and which were not all purchased in Italy. The authorities decided that they could be exported upon payment of the duty but that he must pay the fine by false declaration. For this reason it would be well for visitors to Taormina to be warned of the existing conditions. The antiquarian who sells a piece of old furniture will naturally not find it to his interest to inform his customer of the regulations and, therefore, the Consul suggests that the only safe method for the purchaser to pursue would be to stipulate that payment be only made when the bills of lading of the steamer on which his goods are shipped are placed in his hands. Complaints have frequently been made by purchasers who only too late discovered that even after they had paid for their goods they could not export them. The conditions at present are such that a person not conversant with the law may purchase a genuine antique from a dealer only to discover that the exportation of his purchase is actually prohibited, and his only recourse is to make a legal claim against the seller which is a most expensive proceeding.

THE PRODUCTION OF OOLONG TEAS.

In Formosa the leaves used in the preparation of Oolong teas are picked by women and children chiefly, and as picked they are placed in closely woven baskets which are sometimes lined with jute cloth. When delivered by the pickers to the curing house the leaves are spread out in the open air, in the sunshine if possible, on a bamboo mat or in low bamboo trays, and are there stirred every five or seven minutes until the leaves are somewhat wilted, the edges pliable, and signs of fermentation are visible. The length of time required for this depends upon the sun, temperature, and similar conditions. The tea is then placed in bamboo trays, about four pounds in a tray, which are placed in a rack one above the other, with enough space between to permit free circulation of air and to enable the workmen to manipulate the leaves. The leaves are stirred up in these trays at intervals of from seven to twelve minutes as required, the fermentation being regulated and kept as even as possible in this manner. Fermentation ordinarily is allowed to proceed for about two hours after which a rack of tea, about 40 pounds of the leaf as a rule, is turned into a large circular bamboo tray and is again stirred and manipulated for two hours more, at the end of which time the edges of the leaf are somewhat dry, reddish brown in colour, and have an odour of prepared tea. The leaf is then taken, in lots of four or five pounds, and placed in metal-firing pans over charcoal fires, hot enough to wilt and curl the leaf, giving it the soft, sponge-like quality of damp tea leaves, and enabling it to be rolled, this firing or wilting being accompanied by rapid stirring and tossing the leaf in each pan. The lot of tea is then turned into a round-bottomed pan fixed in the end of a bench, upon which a workman sits, and the leaf is then rolled by hand to give it something of the form of ordinary country-cured Chinese or Japanese teas. The tea is given a second pan drying, followed by another rolling, and sometimes even by a third drying and rolling, although generally two rollings suffice. This rolling is followed by a drying sufficient to get the leaf in such shape that it can be transported to the firer for export. This alternate process of drying and rolling varies with the weather, and indeed the whole process depends upon the conditions surrounding the leaf. The American Consul at Amoy says that the process takes the green leaf, oxidises or ferments it until the edges turn a reddish brown and the entire leaf is wilted; then wilts the leaf over a fire until it can be rolled to give it form, later drying it for temporary packing. This latter process often includes a light firing in a basket over a charcoal fire. The tea thus prepared for temporary keeping is known as "green leaf." It is packed in jute bags holding about sixty-six pounds, and is transported to the export firer. The leaf thus packed is dry, but it lacks the brittle condition of the tea as it is received abroad, and generally is much lighter in colour than oolong as known to the trade. When received at the firing-house it is picked over by women and girls for the removal of stems, dirt, or foreign matter generally. The final firing for export is done in bamboo baskets, giving the name of "basket fired" to the product. The firing which produces characteristeristic oolong is generally done in a medium-sized room in some of the great brick buildings in which the large tea establishments are housed. In a firing room, a brick platform about twenty inches high is constructed, in which are round holes about two feet deep and two feet in diameter, ordinarily about a foot apart, and numbering from 50 to 300 or even 400 in one establishment. In each one of these holes a charcoal fire is built, and the charcoal is burned until all flame disappears, the room becoming a great furnace into which coolies rush with covered mouths and nostrils to stir the fires and prepare the little furnaces. When finally the charcoal in each hole or furnace becomes a bed of live coals without flame, it is covered with charcoal ashes to temper the heat, and preserve the fire. The entire room is still hot and is maintained in that condition for days at a time. Ordinarily it will require perhaps twelve hours to burn the charcoal to a proper condition and have the room at a proper temperature, the covered charcoal giving off a steady heat. The firing is done in bamboo baskets about three feet high and a little over two feet in diameter, open at both ends, and with a sieve placed a little below the centre as a bottom. Such a basket is placed over an open furnace or hole in the brick platform, and about seven pounds of the green leaf

are placed in it. The leaf is practically untouched for about three hours until the quantity of leaf in the basket has become thoroughly and evenly heated, naturally running through a slight wilting in becoming heated. Firers then pass from basket to basket stirring the leaf, so as to keep the drying process even and regular; ordinarily about an hour between the stirrings being sufficient. It generally requires from seven to twelve hours of such firing to evaporate thoroughly all moisture in the leaf, baskets generally being set in the evening and removed in the morning, the tea being boxed while warm. The firing of the tea also varies, for the variety of tea desired, heavily fired teas being desirable for some markets because of the darker infusion they give. Machine curing of tea has been attempted in Formosa, and the Japanese Government is now supporting an experimental machine plant at Anping, Formosa. It is generally agreed by tea men, however, that the results so far have not been successful or satisfactory from any standpoint, and that the plant is run at a loss. There is no present likelihood of the machine method succeeding that of hand firing. The fact is that while, of course, oolong tea derives more or less of its meritorious qualities from the nature of the leaf itself, there is peculiar merit in the manner in which the leaf is handled, and much depends upon little things which a machine cannot accomplish.

DREDGERS IN GOLD DREDGING.

Mr. Consul-General Bennett, in his report on the trade of California and neighbouring States, gives an interesting description of the remarkable dredges now used in the industry of gold dredging in California. These dredges are owned principally by close corporations, and it is difficult for an outsider to obtain any stock in the concerns. Many of them are said to bring in from 700 to 1,000 dollars a day to their owners from lands which were, up to quite lately, looked upon as mineral-bearing districts. Fabulous prices have been paid for farm land wanted for dredging purposes, some worth only 20 dollars an acre as farm land having been sold at 500 dollars an acre. In the course of the ages many rivers in Western America having torrential sources in mountain ranges have washed down large quantities of the gold to the valleys, and frequently changing course have scattered it over wide areas. The substratum just above bed-rock is often peculiarly rich in yellow sands, and it is in such districts that the dredger is most productive. To-day, instead of making, as formerly, futile efforts to expel the seepage water and the underground lakes and rivers, the dredgers dig a lake-bed bank up the sides and launch themselves on an artificial sea, seeking additional water supply from mountain streams if necessary to form their navigable basin. Mr. Bennett's description of the dredgers is as follows:—

A great steel ladder extends in front of the machine like an inverted bowsprit upon which run the bucket-shaped ploughs, with mouths of forged manganese steel. Driven by a powerful marine engine they delve into the bank ahead, literally eating it up. Gorged with rock and sand the buckets mount a ladder again and are carried back to a rotating cylindrical screen, into which they discharge their contents at the rate of thirteen buckets a minute, each bucket containing five cubic feet of earth and rock. Five thousand gallons of water per minute are simultaneously forced into the revolving mass. The screens make twenty revolutions a minute. All the principles known to mining are combined in the winnowing process. Tables fitted with eccentric cams, to hold down coverings of cocoanut matting and expanded metal, catch the gold particles. Rifles containing mercury and amalgam plates are also used, but the cocoanut meshes are depended upon to catch most of the gold. These mats are frequently put through a process of washing in a tank, and the sediment which collects in the bottom is run through a centrifugal amalgamating machine. The amalgam is then heated, the quicksilver expelled, and the fine gold remains, the whole process being done by machinery. Obstacles too large to pass through the perforations in the rotation screen travel out at the end of the cylinder, and by means of a mechanical conveyor are carried out and dumped in the refuse heap at the stern of the dredge. All the *débris* collects at the bottom of the artificial sea in which the dredge floats, and when the water runs off the soil is buried far beneath the surface. It is estimated that less than 1 per cent. of the gold in the path of the dredge is lost. Placer fields which have been worked over five or six times, and even discarded dumps of old mines are yielding rich profits. A winchman in the conning tower controls the whole mechanism and with, at times, a single deck hand, composes the crew of the 300 ton ship. It is said that earth can be handled by them at a cost not exceeding 3 and 4 c. a cubic yard, and that the total expense per day of operation is only 30 dol. The vessels themselves cost from 50,000 to 95,000 dol. according to size. Many of them are alleged to return a profit of more than 600 per cent. There are over 100 of them in operation on the Pacific Coast, and as each can devour one acre of earth per month 100 agricultural acres are being permanently destroyed every 30 days.

PURE FOOD LEGISLATION IN FRANCE.

A new law has recently been passed in France protecting consumers from imitation champagne and other wines, imitation cheeses of all kinds, as well as all food products, and many other articles of French

production, the reputations of which have been built up by certain localities as places of production and manufacture. The law is very broad in its scope, and includes in its protecting provisions practically every article of food produced in France, while it aims to give protection to the producer and the place of production as well as to the consumer. It contemplates, for instance, that if Roquefort cheese is produced in a certain district of France, that this district has built up the world-wide fame that Roquefort cheese possesses, and has developed its manufacture to perfection with the reputation of this particular cheese to maintain, that the article and the consumer should be protected, that the district where Roquefort cheese originated should be protected as the place of production and the place of manufacture; that as genuine Roquefort cheese is made from ewes' milk, it is not Roquefort cheese at all if mixed with cows' milk, or other materials as is often the case. In the same way, according to the American consul at Rheims, such cheese as Cantal, Port-de-Salut, Sept-Moncel, Gex, Sassenage, Gruyère, Gérome, Void Olivet, Rollot, Brie Camembert, Coulomniers, Livarot, Neufchatel, Mont d'Or, Troyes, Gournay, Gervais, Bondon, Mignot, Pont l'Evéque, and others are to be protected. "Pâté de foie gras," prepared from the liver of the goose, is a select French delicacy produced and manufactured in Lorraine, which originated and perfected this industry. Now it is proposed to protect the district and consumers from imitations under the same name, "Pâté de foie gras." Burgundy has produced "Burgundy" wine for centuries, and Champagne has produced "Champagne" grapes since the fifth century or earlier. The new law will not permit any materials grown outside these districts to be manufactured into wine to be called "Burgundy" or "Champagne." Neither can the materials from these districts be carried away and manufactured into "Burgundy" or "Champagne" elsewhere.

Each district is protected as a place of production and a place of manufacture as applied to localities where the production depends upon a particular soil and climate. The French legislators believe this is the only way to secure protection against fraud. The articles cannot be produced or manufactured away from the districts which established the reputation, any more than another who is not the owner of a registered trade mark can manufacture and sell an article labelled with the trade mark that carries a great reputation with it. To illustrate in another way the idea of the new law—"Marseilles soap" is a low-priced soap with a great reputation in France, and other countries of Europe. The materials from which this soap is made, however, are not produced exclusively in any particular district or country, and never were. The manufacturers purchase the materials in France and from other countries, therefore the law does not essay to protect Marseilles soap and similar commodities. Such articles in the protection given are matters of a registered trade mark only, and the new law does not apply. There have been laws in existence in France for many years protecting certain commodities, and while there have been many convictions, particularly of the makers of imitation champagne, the law has been considered inadequate. The new law carries the several penalties in both fine and imprisonment.

GERMAN ATTEMPTS AT COLONISATION.

The question of colonisation appears to be an absorbing one in Germany, and a good deal of money has been spent and wasted in the attempt to establish colonies that will produce a financial return, but as yet practically no great success has attended the efforts made. The German Government holds that in time the colonies will prove invaluable as a place of settlement for the overflow population at home, and that when settled they will serve as a sure market for German manufactures, and as a source from which the necessary raw materials may be drawn for home industries. When, in 1881, not less than 220,000 Germans emigrated to America, the German Government began to show greater interest in the acquisition of colonial territory in various parts of the world, with the intention of guiding emigration from the mother country to these new possessions, but German emigrants refused to go to these colonies. The tide of emigration to America began to ebb, until it fell off to about 10 per cent. of the former number. According to the American Consul at Chemnitz, in the acquisition of colonies Germany came upon the scene too late. Such countries as were naturally adapted through climatic conditions for settlement by white races had already been occupied by other nations. The colonies which Germany has acquired do not afford opportunities, such as German emigrants as a rule want, to induce them to emigrate. South-west Africa, which has been the scene of a disastrous and dilatory war for nearly three years, is the only German colony favourable for European settlement, and this land is so poorly supplied with water that an area of from 5,000 to 10,000 acres is necessary to keep alive the herds of even a small ranch. It has been estimated by good judges of the country that only about 7,000 farmers with their families could find room for settlement there. The highlands in such tropical countries as East Africa, Cameroons, and the South Sea Islands, are likewise limited, as far as suitable opportunities are concerned, which offer a possibility of being settled and cultivated by European emigrants. The growth of trade between Germany, the four protectorates in Africa, Kiautschou, and the possessions in the South Sea Islands, is beginning to assume a very favourable aspect. In 1903 these colonies as a whole imported over £3,000,000 worth of merchandise, and exported over £1,800,000 worth. The greater part of this business was done with Germany. There is no preferential tariff in any of

these countries in favour of the mother country, but Germany, it is said, intends to establish such tariffs whenever the countries are in a condition to warrant such a course. It is generally understood that a great sum of money must be expended in building railways, and otherwise developing these colonial possessions, before any considerable emigration can be hoped for in that direction. It is claimed by many in Germany that if a good part of the surplus population could be diverted to Asia Minor, the field for emigration and colonisation would be happily chosen, for the reason that the German would never assimilate with the Turk or Arab; therefore the colonies would remain German in sentiment and not sacrifice their nationality, as has been the case in the United States, South America, and the English colonies, by becoming citizens of those countries. There is something in this argument, and undoubtedly true is the fact that such colonies are destined to play an important part in the expansion of German commerce in Asiatic countries. It may not be a generally known fact, but it is true, nevertheless, that there are already a number of exclusive German colonies scattered over Asia Minor, engaged chiefly in gardening, which are as thriving as any colony of the same race established in Brazil or any part of Russia, which to-day form such valuable assets to those countries. In view of the enterprise already shown by German residents in a country which is acknowledged to be exceedingly rich, and replete with vast opportunities in connection with cotton, grain, oil, fruit, &c., it is hoped that this will lead to the establishment of large German agricultural colonies in the vicinity of the cities and stations along the Bagdad route, similar to the one which has been very prosperous at Jaffa.

UTILISATION OF WATERWAYS IN GERMANY.

According to a recent report of the American Consul-General at Frankfort, a monograph has been prepared in the Prussian Department of Public Works on the subject of the utilisation of the water-power created through the canalisation of the rivers Moselle and Saar. It states that at the dams of the Moselle in Prussian territory, about 35,000 horse-power, and in the territory of Lorraine, about 5,000 horse-power, and at the dams of the Saar, about 10,000 horse-power will be available, making in all a total of 50,000 horse-power. This power will not at once be utilised at all the dams, and, if so, not to the full extent. For supplying larger amounts of power to the existing iron furnaces in Lorraine and in the Saar district, it is unfavourable that the furnace gases developed in the process are already used for generating power. For the larger cities, as Coblenz, Trier, and Metz, however, the power of the dams in the vicinity could be profitably used, and the existing steam-electricity works could be utilised as a reserve and supplement for the water-power created by the new dams. This water-power could also be made useful in running short railway lines—as, for instance, the recently-constructed Moselle Valley Railway from Trier to Bullay—for the navigation of the canal in operating the sluices and guards, and could be supplied to the villages in the Eifel and Hunsrueck mountains, whereby home industries could be created in these poor districts. The expenses for a water-power station consist of the cost of the turbine plant, and that of the creation and distribution of the electric current. No expense is incurred in the construction of a dam in the river, as it already exists in the interest of navigation. The utilisation of the water-powers, which in Germany has not hitherto received much consideration, will serve the public welfare on the one hand, and on the other is expected to assist materially in raising revenue for the purpose of canalisation.

THE FRENCH TOBACCO MONOPOLY.

The receipts for the year 1904 of the French tobacco monopoly, which have just been made public, amounted to £18,015,000, an increase of £525,000 over those of 1903, and the expenses to £3,319,000, a decrease of £67,000 as compared with 1903. Thus the total profits amounted to £14,696,000, an increase of £540,000 over those of 1903. The sale of cigars increased 6·81 per cent. and aggregated 5,861,188 pounds; cigarette sales increased 5·64 per cent. and were 4,825,606 pounds. The cut packet tobacco ("scaferlati") showed the greatest increase in popularity, 62,479,253 pounds being sold, or 72·63 per cent. more than the previous year. The superior quality of "scaferlati" is stated to be principally composed of American tobacco, the product of French cultivation being used for the ordinary quality. Roll and chewing tobacco sales were 2,603,325 pounds, or 3·03 per cent. more than in 1903. Of tobacco powder, the sales increased 11·89 per cent. to 10,230,465 pounds. The average rate of tobacco consumption in France for 1904 was 35·23 ounces, the value being 10s., of which sum about 9s. 2d. were returned to the Treasury. The production of tobacco in France amounted in value to £750,000, as against £862,000 in 1903. There was a small decrease in 1904 in the number of tobacco planters and in the average yield per acre. The increase of tobacco imports into France during 1904 was considerable. From Kentucky, Maryland, Ohio, and Virginia came 2,623 more tons of leaf tobacco than in 1903, or a total of 16,595 tons, while from Havana, Mexico, Sumatra, Java, and the Levant came 3,196 tons, an increase of 22 tons. From Hungary, Astrakhan, Java, &c., 4,139 tons were received for "scaferlati." The 1904 imports of cigars of foreign manufacture were 47 tons, and of cigarettes 66 tons.

HOME INDUSTRIES.

Capital in British Railways.—Excluding nominal additions, the capital expended by our railways up to the end of last December amounted to £1,088,421,000. Of this sum about £100,000,000 has been spent in the acquisition or construction of steamboats, canals, harbours, docks, &c. And there has been an expenditure of about £25,000,000 upon the securities of other companies. Excluding these sums, the *Statist*, from which these figures are taken, finds that the capital devoted to building and equipping the 22,634 miles of railway which serve the United Kingdom was at the end of 1904—the latest date for which the complete figures are available—in round figures £950,000,000. Of this amount approximately £54,000,000 was expended upon waggons, £37,000,000 upon coaching stock, £43,000,000 upon locomotives, and £816,000,000 upon the construction of the permanent way, sidings, yards, signals, works, and stations, which is equal to £36,054 per mile of road, and to £13,867 per mile of track, including sidings. Nor does this represent the total sum expended seeing that about one half of the waggons which run over our railways, and convey the greater portion of the traffic of the country, are owned by private traders. The number of these waggons is computed at 800,000, and assuming them to be valued at somewhat over £30 per waggon, the capital invested by private traders in railway waggons at the end of 1904 was £25,000,000. At the approximate first cost the figures would be £50,000,000, so that the total capital expended for purely railway purposes reached to at least £975,000,000. Add allied industries, including steamboats, canals, harbours, &c., and the total capital spent reaches £1,100,000,000. If we go back to 1870, when the industry was fully established, and when uniform figures were compiled, it will be found that the sum then expended for purchasing the land and constructing the 15,537 miles of railway at that time existent was £407,000,000, or £26,196 per mile of road. But whereas £407,000,000 sufficed for 15,537 miles of road, the total cost of the construction of the present mileage of 22,634 has been £816,000,000, so that with an increase of only 7,097 miles of roadway the additional capital expended has been £409,000,000, which on the face of it would seem to imply that the mileage constructed since 1890 has cost £57,000 per mile, and that, of course, is not the case. In fact, the additional miles of road represent only a small portion of the new construction work that has been performed. To deal with the increasing number of trains much of the railway system has been widened, and, including the miles of track, and the miles of railway, probably our railway system has been nearly doubled since 1870.

The Irish Railways.—It is known that the present Chief Secretary for Ireland is in favour of the State taking over the Irish railways, and it is thought not unlikely that the present Government will deal with the subject. As far back as 1834 a Royal Commission reported in favour of State assistance, and the following resolutions were passed in the House of Commons:—1. "That the Irish railways shall be constructed with money supplied by the British Treasury, and that they shall be under State control." 2. "That the revenue from the lines shall be applied—first, in their maintenance; secondly, in the payment of 3½ per cent. on their cost; thirdly, in repayment of the cost by instalments of 1½ per cent.; and, fourthly, in reducing the rate of carriage." Nothing came of these resolutions, and private companies were allowed to proceed with the work, as in England and Scotland. There can be little doubt that if the recommendations of the Royal Commission, and the resolutions referred to above, had been acted upon, it would have been greatly to the benefit of Irish industries. As it was, a great number of small companies, with expensive management, sprang up, and even now, after many of them have been absorbed by the larger concerns, there are some thirty of them. If the railways were taken over by the State, it is estimated by competent authority that savings amounting to £1,000,000 a year could be effected. Railway companies have to incur heavy expenses which would not be necessary if there were State control. For example, the large sums spent in promoting or opposing Bills in Parliament. The thirty Boards of Directors, too, with their staffs, would be rearranged so as to effect a great saving, whilst the Clearing House, with its 128 clerks, would no longer be necessary. Nor would it be necessary for the Government to raise any money on the market, since the present shareholders might be expected to take stock in lieu of money. It is assumed that the State purchase of the Irish railways would mean a considerable reduction of rates, more especially for agricultural produce. In this respect Ireland is under heavy disadvantage as compared with other countries. In the United States and in Canada railway rates for agricultural produce are under a farthing a ton per mile; on the Continent they are about two farthings; in Ireland they are five farthings. The average rate for merchandise, too, is much in excess of the rates in England and Scotland. A system such as might be hoped for from the State control of Irish railways, which would enable the farmers and traders to send small parcels at a cheap rate, should be of great advantage to Irish agriculture, and it is not surprising that there is something like a general desire in Ireland for Government purchase of the railways.

The Leather Industry.—Since reference was last made in these Notes to the leather trade, and its supplies of raw material, prices, then very high, have continued to rise; and, so far as can be seen, further enhancement of price is more probable than a return to lower rates. As with tin, whilst the world's consumption has largely increased the supply of hides continues restricted, more especially the imports from

Australasia, South Africa, and India. The great demand from America for raw material continues, and how great that demand is, is illustrated in the official figures of the United States Treasury, which show that the value of hides of cattle—dutiable, for the nine months to March, which in 1905 was 10,139,648 dols., rose in 1906 to 15,873,509 dols., the value of the hides and skins imported free in the same period rising from 35,543,271 dols. to 43,844,484 dols. The motor industry has increased the demand for superior grade leather very largely, and this demand must continue to grow rapidly with the expansion of this new and immense industry. Motor clothing and sundry other minor branches in this connection also have accounted for a largely increased demand for various kinds of sheep leather which must go on increasing. The appreciation of leather values during the last year or so, ranging from 75 per cent. to 100 per cent., has not been able to check the growth of the general demand, and it is not likely that for some time to come the supply will catch up the demand.

An Industrial Census.—There is ground for hope that the Government will proceed with an Industrial Census Bill. For more than fifty years the United States census has given the data which this Bill would require, and for the last three censuses the schedules for each industry have been prepared by experts in the particular inquiry assigned them to investigate. The printing of the information would be compulsory, but, of course, individual returns would be treated as confidential as is done with regard to income-tax returns. The results of these inquiries in the United States have been of great value from an economic point of view, and have made it much easier to gauge the industrial progress of the country. It is urged in opposition to the new departure that such information would be of value to our commercial rivals as showing our strong industries and indicating the best points for renewed assaults. But it may well be doubted whether the census would tell our foreign rivals much with which they were not already acquainted. Nowadays publicity is too general to allow of much secrecy in trade, or in other matters. The statistics of our foreign trade and of our home trade are both full and comparatively accurate, but little is known about home production and home consumption. And yet these are the most important factors in our industrial prosperity.

The "Lusitania."—There is natural and general satisfaction at the launch of the *Lusitania*, which promises at no distant date to restore to the British flag the supremacy in speed of the Trans-Atlantic service which passed to the German flag with the North German Lloyd steamship *Kaiser Wilhelm II.* in 1903. This vessel has a speed of 23½ knots. The *Lusitania* will be able to maintain a minimum average ocean speed of from 24 to 25 knots in moderate weather. In order to give her this superiority over the German vessel the engine-power must be from 60 to 70 per cent. greater than that of the *Kaiser Wilhelm II.*, and the coal consumption proportionately increased. A thousand tons of coal will have to be put into the furnaces in every 24 hours of the passage, and it may well be asked whether the gain of a knot an hour over the German ship is worth the immense outlay necessary to secure it. However that may be, the *Lusitania* promises to represent the greatest achievement in shipbuilding known to the world, and is welcome evidence that our shipwrights are still equal, if not superior to, any rivals. Everything seems to have been done in the way of design to make the ship not only the largest, but the most complete craft afloat; provision has been made for 550 first-class, 500 second-class, and 13,000 third-class passengers, whilst the complement of officers and men will reach nearly 800. Most careful consideration, says Sir William White, who is the consulting Naval Architect to one of the firms entrusted with the design and construction of the vessel, has been given to the arrangements of boilers and coal bunkers, in order to obtain maximum efficiency and economy of labour. Experimental enquiries were combined with scientific calculation: every precaution was taken to obtain the best results as regards form, dimension, economical strength, stability, good behaviour, passenger accommodation, and efficient working of the propelling apparatus. High tension steel has been used extensively in the holds for the purpose of associating more fully strength with lightness. The watertight supply division is very thorough, and is much improved by the introduction of the four turbines which are placed in three separate engine-rooms. Happily, all went well at the launching, and it may be hoped that the future of the vessel will be worthy of the skill employed in creating her.

GENERAL NOTES.

The Suez Canal.—In his report on the trade and commerce of Port Said for 1905 (Cd. 2682), Mr. Consul-General Cameron gives some interesting particulars of improvements effected in the Suez Canal. Its navigable dimensions are now practically doubled to what they were twenty years ago, the superficies of the vertical profile having been increased from 320 to 580 square metres in the ordinary channel, and to 740 square metres in the numerous gares or crossing places. From 1898 to 1904, owing to the increasing size of ships, larger gares were begun, some twenty in number, at intervals of three miles, each gare having a length of 820 yards, with approaches of 328 yards at either end. At each gare the bottom

width of the canal is 50 yards, the width at the water level over 100 yards, the depth of the gare itself being 31 feet. Taking the canal as a whole, its width at the water level on the Northern half is from 100 to 120 yards, and in the southern half from 80 to 100 yards. In 1902 the maximum draught was raised from 25 feet 7 inches to 26 feet 3 inches. On January 1st, 1906, the maximum was raised to 27 feet. The orignal tariff for laden ships was 10 frs. per ton in 1869; this was raised to 13 frs. in 1874; it was lowered half a franc per year from 1877 to 9 frs. in 1893, and to 8½ frs. in 1903. On January 1st, 1906, the tariff was reduced to 7 frs. 75c. For ships in ballast the tariff has always been 2 frs. 5 oc. less. The 10 frs. rate for passengers has never been changed. 41,116 vessels, of a net tonnage of 13,134,105 tons, passed through the canal in 1905, as compared with 4,237 vessels, of 13,401,835 tons, in 1904. The transit receipts were 113,829,667 frs., as against 115,733,607 frs. in 1904. The mean net tonnage has risen from 1,000 tons in 1871, to 3,191 tons in 1905. The mean duration of transit remains about the same, namely, eighteen hours for all vessels, but the general effective rate for mail steamers is fifteen hours. The use of the electric light is practically universal, amounting to 96 per cent. The British net tonnage, 8,356,940, shows a decrease of 476,989 tons as compared with 1904. The British per centage in number of vessels was 60·4, and in tonnage 63·6. These figures apply only to the general total checking. Taking the merchant vessels only, the British percentages have steadily risen during the last five years from 67 to 74 per cent. in number, and from 71 to 77 per cent. in net tonnage. During the last four years, the German percentage in number of ships has risen from 13 to 14·6 per cent., and their tonnage from 15 to 16 per cent. Whilst British shipping may be said to be holding its own, the leading German lines of steamers are showing great enterprise. Their mail and passenger steamers are increasing in size, and their companies appear to be very well managed.

Smuggling in the Persian Gulf.—In his report on the trade and commerce of Bushire for 1905 (No. 3581, Annual Series), Mr. Vice-Consul Richards refers to the large and increasing amount of smuggling in the Persian Gulf, consequent upon the heavy duties. All articles bearing a heavy duty are largely smuggled into Persia through the means of native boats, and the various small ports. The goods, as a rule, are brought to Muscat, Oman, Dabai, Dahrein, and Koweit, by steamers from Europe and India. The trade in these parts is far in excess of their actual requirements, and from these ports systematic smuggling is carried on with the smaller Persian Gulf exports notwithstanding the vigilance of the European staff of the Customs Administration. Gums, teas, spices, indigo, all bearing high duties or protected, are smuggled into the country, while wheat and barley are smuggled out of it. It is estimated that from 40,000 to 45,000 tons of wheat and barley were smuggled from the various small ports of Southern Persia during 1905 to Busrah, Koweit, Bahrein, and Arab ports. This is due to the fact that the duty according to the tariff, which is 1 kran per 10 batmans on wheat and barley alike, is equal to 15 to 20 per cent. on the former and 30 to 40 per cent. on the latter, which has so seriously affected the export of grain from Bushire by *bonâ-fide* traders that only 476 tons were exported in 1905, although the harvest was as good, if not better than in 1894 when some 40,000 to 50,000 tons were exported.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 18...Geographical, University of London, Burlington-gardens, W., 8½ p.m. Major Molesworth Sykes, "Recent Journey and Surveys in Persia."

Tuesday, June 19...Asiatic, 22, Albemarle-street, W., 3 p.m.

Statistical, 9, Adelphi-terrace, Strand, W.C., 5 p.m. Professor F. Y. Edgeworth, "The Generalised Law of Error, or Law of Great Numbers."

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. E. H. Cunningham Craig, "The Oilfields of Trinidad."

Wednesday, June 20...Meteorological, 70, Victoria-street, S.W., 4½ p.m. 1. Discussion on Mr. R. G. K. Lempfert's paper, "The Development and Progress of the Thunder Squall of February 8th, 1906." 2. Mr. Frederick J. Brodie, "The Mean Prevalence of Thunderstorms in various parts of the British Islands during 25 years, 1881-1905." 3. Mr. W. H. Dines, "Note on a Typical Squall at Oxshott, May 25th, 1906."

Microscopical, 20, Hanover-square, W., 8 p.m. The President, "On the Structure of some Carboniferous Ferns."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Thursday, June 21...Royal, Burlington-house, W., 4½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Miss L. S. Gibbs, "The Botany of Southern Rhodesia." 2. Mr. W. Carruthers, "The Authentic Portraits of Linnæus." 3. Dr. Otto Stapf, "Plantæ Novæ Daweanæ in Uganda Lectæ." 4. Mr. W. U. Resché, "The Genitalia of Diptera."

Chemical Burlington House, W., 8½ p.m. 1. The Cleeve Memorial Lecture, by Prof. T. E. Thorpe. 2. Messrs. F. B. Power and F. Tutin, "The Constitutents of the Essential Oil from the Fruit of Pittosporum Undulatum." 3. Messrs. J. T. Hewitt and H. V. Mitchell, "Mobility of Substituents in Derivatives of β-naphthol."

Numismatic, 22, Albemarle-street, W., 6½ p.m. Annual Meeting.

Friday, June 22...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

Journal of the Society of Arts.

No. 2,796. VOL. LIV.

FRIDAY, JUNE 22, 1906.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal* in accordance with Sec. 40 of the Society's By-laws:—

TREASURERS' STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDING MAY 31ST, 1906.

Dr.

	£ s. d.	£ s. d.
To Cash in hands of Messrs. Coutts and Co., 31st May, 1905		2,397 9 4
,, Subscriptions	5,865 6 0	
,, Life compositions	504 0 0	
		6,369 6 0
,, Dividends and Interest		680 14 9
,, Ground Rents		646 2 6
Examination Fees		3,294 13 0
,, Conversazione, 1905 (sale of tickets)		112 10 0
,, Advertisements		723 7 6
,, Sales, &c.:—		
"Cantor" Lectures	58 3 1	
Examination Programmes	49 14 6	
Fees for use of meeting-rooms	53 11 0	
Journal	145 10 10	
		306 19 5
,, Donations to Examination Prize Fund:—		
Goldsmiths' Company	50 0 0	
Clothworkers' Company	30 0 0	
Skinners' Company	5 5 0	
		85 5 0
,, Sale of Consols and War Loan for re-investment		2,992 11 0
,, Committee on Leather for Book-binding:—		
Leathersellers' Company	250 0 0	
Sale of Reports	17 4 5	
		267 4 5
		£17,876 2 11

Cr.

	£ s. d.	£ s. d.
By House:—		
Rent, Rates, and Taxes	837 13 8	
Insurance, Gas, Coal, House expenses and charges incidental to meetings	424 2 4	
Repairs and Alterations	20 10 11	
		1,282 6 11
,, Office:—		
Salaries and wages	2,297 5 5	
Stationery, Office Printing and Lithography	486 15 1	
Advertising	101 19 0	
Postage Stamps, Messengers' Fares, and Parcels	402 0 7	
		3,288 0 1
,, Library, Bookbinding, &c.		94 13 7
,, Conversazione (1905)		406 3 0
,, *Journal*, including Printing and Publishing		2,439 14 10
,, Advertisements (Agents and Printing)		323 14 0
,, Examinations		3,576 11 7
,, Medals:—		
Albert	20 18 0	
Society's	27 18 6	
		48 16 6
,, "Owen Jones" Prizes		16 16 0
,, Drawing Society's Prizes		11 12 8
,, Juvenile Lectures		25 0 0
,, "Howard" Lectures		30 0 0
,, "Cantor" Lectures		278 11 6
,, Sections:—		
Applied Art	60 0 0	
Colonial	55 9 1	
Indian	69 19 11	
		185 9 0
,, Committees (General Expenses)		19 18 3
,, Committee on Leather for Bookbinding		217 12 5
,, Investments:—		
Newcastle $3\frac{1}{2}$ per cent. Stock	2,984 1 9	
War Loan	10 2 0	
		2,994 3 9
		15,329 4 1
,, Cash in hands of Messrs. Coutts and Co., May 31st, 1906		2,546 18 10
		£17,876 2 11

Liabilities.

	£	s.	d.	£	s.	d.
To Sundry Creditors	766	9	7			
,, Examiners' Fees	1,076	16	6			
,, Examination Prizes and Medals	200	0	0			
,, Sections:—Applied Art, Colonial, and Indian	160	0	0			
,, Accumulations under Trusts	385	11	10			
				2,588	17	11
,, Excess of assets over liabilities				25,134	8	8
				£27,723	6	7

Assets.

	£	s.	d.	£	s.	d.	£	s.	d.
By Society's Accumulated Funds invested as follows:	Amount of Stock, &c.			Worth on 31st May, 1906.					
Newcastle-on-Tyne $3\frac{1}{2}$ per cent. stock	3,000	0	0	3,075	0	0			
Canada 4 per Cent. Stock	500	0	0	505	0	0			
South Australia 4 per Cent. Stock	500	0	0	510	0	0			
N.S. Wales $3\frac{1}{2}$ per Cent. Stock	530	10	1	527	16	10			
N.S. Wales 4 per Cent. Stock	500	0	0	550	0	0			
G. Indian Pen. Ry. 4 per Cent. Debenture Stock	217	0	0	260	8	0			
Queensland 4 per Cent. Bonds	1,500	0	0	1,537	10	0			
Natal 4 per Cent. Stock	500	0	0	540	0	0			
Ground Rents (amount invested)	10,496	2	9	10,496	2	9			
Metropolitan Water Board B. Stock	321	15	9	304	1	0			
New River Co. shares	6	0	0	6	0	0			
National War Loan	3,134	8	3	3,095	4	5			
	21,205	16	10				21,407	3	0
,, Subscriptions of the year uncollected				751	16	0			
,, Arrears, estimated as recoverable				323	0	0			
							1,074	16	0
,, Property of the Society (Books, Pictures, &c.)							2,000	0	0
,, Advertisements due							294	8	9
,, Cash in hands of Messrs. Coutts and Co., 31st May, 1906							2,546	18	10
,, Do. on Deposit (against interest on Trusts)							400	0	0
							£27,723	6	7

Funds held in Trust by the Society.

	£	s.	d.	
Dr. Swiney's Bequest	£4,477	10	0	Ground-rents, chargeable with a sum of £200 once in five years.
"John Stock" Trust	100	0	0	Consols, chargeable with the Award of a Medal.
"Benjamin Shaw" Trust for Industrial Hygiene	133	6	8	,, ,, ,, of Interest as a Money Prize.
North London Exhibition Trust	192	2	1	,, ,, ,, ,,
"Fothergill" Trust	388	1	4	,, ,, ,, of a Medal.
J. Murray, in aid of a Building Fund	54	18	0	,,
Subscriptions to an Endowment Fund	562	2	2	,,
Dr. Aldred's Bequest	220	2	3	,, chargeable with the Award of a Prize.
Thomas Howard's Bequest	571	0	0	Metropolitan Railway $3\frac{1}{2}$ per Cent. Preference Stock, chargeable with the Award of a Prize for an Essay.
Dr. Cantor's Bequest	648	19	7	Bombay and Baroda Railway Guaranteed 3 per cent. Stock } Interest applied to the Cantor Lectures.
	3,273	16	6	India 3 per cent. Stock }
	2,695	11	3	Ground-rents }
"Owen Jones" Memorial Trust	423	0	0	Canada 4 per Cent. Stock, chargeable with the Award of Prizes to Art Students.
"Mulready" Trust	105	16	0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
Alfred Davis's Bequest	1,953	0	0	Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
Amount to cover accumulated Interest on Trust Funds	400	0	0	On Deposit with Messrs. Coutts and Co.
	£16,199	5	10	

TOTAL OF INVESTMENTS &c., STANDING IN THE NAME OF THE SOCIETY (INCLUDING SOCIETY'S ACCUMULATED FUNDS AND TRUSTS AS ABOVE).

Ground Rents (amount of cash invested)	£17,669	4	0
Consols	1,650	12	6
Metropolitan Railway $3\frac{1}{2}$ per Cent. Preference Stock	571	0	0
Bombay and Baroda Railway, Guaranteed 3 per cent. Stock	648	19	7
India 3 per cent. Stock	3,273	16	6
Canada 4 per Cent. Stock	923	0	0
South Australia 4 per Cent. Stock	605	16	0
New South Wales $3\frac{1}{2}$ per Cent. Stock	530	10	1
New South Wales 4 per Cent. Stock	500	0	0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Queensland 4 per Cent. Bonds	1,500	0	0
Natal, 4 per Cent. Stock	500	0	0
Newcastle-on-Tyne $3\frac{1}{2}$ per cent. Stock	3,000	0	0
Metropolitan Water Board B. Stock	321	15	9
New River Company Shares	6	0	0
National War Loan	3,134	8	3
Cash on Deposit with Messrs. Coutts and Co.	400	0	0

Society's Accumulated Funds	21,205	16	10	}	£37,405	2	8
Trust Funds held by Society	16,199	5	10	}			

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs. Coutts and Co., as above set forth, have been duly verified.

CARMICHAEL THOMAS, } *Treasurers.*
GEORGE BIRDWOOD, }

HENRY TRUEMAN WOOD, *Secretary.* KNOX, CROPPER AND CO., *Auditors.*

Society's House, Adelphi, 20th June, 1906.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fifty-second Annual Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 27th June, at 4 p.m.

(By Order of the Council),

HENRY TRUEMAN WOOD,

Secretary.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 3rd, from 9 to 12 p.m.

The central portion of the gardens only will be used. The gardens will be illuminated with coloured lamps, and also by the Kitson incandescent oil light. The Conservatory and the Club-house will be open.

The reception, by Sir Owen Roberts, M.A., D.C.L., F.S.A., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

The Tropical-house, containing the giant water lily (Victoria Regia), and other interesting tropical plants, will be open to visitors.

An exhibition of growing and cut roses and other flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

A selection of music will be performed by the string band of the Royal Artillery in the Conservatory, and by the band of H.M. Scots Guards in the gardens, commencing at 9 o'clock.

Two performances of selections from pastoral plays will be given in the gardens by Mr. Patrick Kirwan's Idyllic Players at 9.30 and 10.30 p.m.

A concert and entertainment by members of Mr. Kirwan's company of Idyllic Players, with choruses by children (Bellew and Stock's choir), will be given in the Club-house at 9.45 and 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These cards have now been issued. A limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

RESOURCES AND TRADE OF CENTRAL AMERICA.

The geography of the six Central American States is so well known as to call for little comment. In order, however, to understand certain features of the commercial development of these countries, it is necessary to emphasise one or two points which are sometimes overlooked. The six States of Guatemala, Honduras, British Honduras, Salvador, Nicaragua, and Costa Rica together, form a long narrow strip of land extending from south-east to north-west over a distance of some 800 miles. The width varies from about 60 miles to over 300, and the total area is estimated at 176,927 square miles. So far as mere latitude is concerned, this entire section is tropical, the northernmost point being in about 18 degrees, and the southernmost in about 8 degrees north latitude. Throughout the entire length, however, runs a backbone of mountains, rising more or less abruptly from the coast, reaching in places, altitudes of 10,000 or 12,000 feet, enclosing many plateau regions, and greatly tempering the climate of much of the interior. The United States Special Agent in Nicaragua, says that probably the most important effect commercially of the presence of this mountain backbone is the difficulty which it presents to transportation between the two coasts, or from either coast, into the interior. The lowest pass from coast to coast is in Nicaragua, with an elevation of between 100 and 200 feet. In the other countries, far greater altitudes have to be overcome; in Costa Rica, for example, over 4,000 feet, and in Guatemala, nearly 5,000. These altitudes have prevented the construction of railways from coast to coast, and have maintained a sort of commercial separation between the west and east slopes of the countries. The western slope belongs still to the commercial sphere of the Pacific, and the eastern to that of the Atlantic. There is at present no railway crossing the whole of the very short distance from the Atlantic to the Pacific side. In some cases such railways have been begun and have been pushed a greater or less distance from one side or the other, or both, and in one or two cases as in Costa Rica and in Guatemala, there are prospects of an early completion. In the main, however, the economical transport of goods from the one coast to the other is at present an impossibility, and even in districts near either coast the carriage of goods is a costly and uncertain affair. Ox carts or pack animals are the burden bearers, and many of the roads which are bad enough even in the dry season become virtually impossible during the rainy months.

The population of the six States is in general very sparse, the total number of inhabitants being estimated at about 4,100,000. This population, however, is very unevenly distributed. The smallest of the six States, Salvador, with an area of but 7,225 square miles, has a population density of 140 per square mile, while the largest, Nicaragua, with an area of 49,200 square miles, has a density of only 8·5 per mile. In both area and population British Honduras is significant (7,562 square miles and about 37,000 inhabitants), but her nearest neighbours, Honduras, Guatemala, and Salvador, constituting the northern half of Central America, form the most important group among the six States. The combined area of these three is about one half of the total area of the six, but their population is about 80 per cent. of the total. The commercial activity of the people, as a whole, is not great. The total imports of the six countries probably reach a value of about £3,350,000 annually, or a little less than sixteen shillings and eightpence per head. The exports are estimated at £5,420,000 or a little more than twenty-five shillings per head. But in this respect, again, great differences are found. Costa Rica is the most active in proportion to population, her export and import trade together reaching nearly £6 5s. per head. The others are far behind, except British Honduras, whose commercial statistics are, however, swelled by a large transit trade, and are therefore misleading. The exports and imports of Nicaragua reach a value of about £2 2s. per head; of Guatemala, £1 17s.; Salvador, £1 9s., and Honduras, £1 6s. Three of the countries in question have been going through a period of commercial depression in the past two or three years, due in part, at least, to poor coffee crops combined with low prices in the world's markets. Those most affected have been Guatemala and Honduras. Nicaragua has suffered in less degree, at least so far as the effect on foreign trade movement has been concerned. Costa Rica has felt the coffee depression less than any of the others, because of the development there of another great industry, banana growing. Thus it is found that in some places foreign trade has declined in recent years, while in others it has grown rapidly. It is probable that the growing sections represent

the more normal condition of the whole, for where decline has taken place it can be traced to causes which are mostly of temporary character. The countries all have great resources, new investments of foreign capital are taking place and new enterprises are being developed. It may reasonably be assumed that the next few years will see a fairly rapid growth of trade in all the countries. The imports of Central America are such as are always characteristic of countries whose industries are chiefly extractive—textiles, implements, tools, machinery and food stuffs. In this respect Central America does not differ materially from most of the countries of South America. It does differ from them, however, in that the United States holds the lion's share of the trade. Taking the six countries as a whole it is probable that the United States supplies at least 50 per cent. of their total foreign purchases. The three principal competitors for the Central American trade are the United States, the United Kingdom, and Germany. The United States stands first in the Central American import trade on all of the countries except Salvador. The United Kingdom takes second place except in Salvador where she leads, and Germany stands third. In Costa Rica, Honduras, British Honduras and Nicaragua the United States appears to have made great gains but has lost ground in Guatemala and Salvador. It has already been mentioned that the industries of these Central American States are chiefly extractive. The products are mainly tropical in character, although in the uplands some few commodities common in temperate climates are also produced. Manufactures in any broad sense of the term are wholly lacking, but in some of the towns small industries, such as beer brewing, ice-making, the manufacture of matches, of furniture, &c., are to be found. The demand for foreign goods, such as tools, implements, &c., is therefore connected almost wholly with the development, not of these embryo manufactures, but of the forest and agricultural industries, and the working of the mineral deposits which are found in some districts. The character of the chief industries, as well as the lines of future development in all of the countries, is perhaps best illustrated by analysing the course of trade and industry in one of them which as already stated has developed the greatest commercial activity, namely, Costa Rica. It is the more satisfactory to do this, as the Statistical Department of that country has developed a high degree of efficiency which renders it possible to obtain very complete data. The chief exports of Costa Rica are coffee and bananas, these two items together making up over 90 per cent. in value of all shipments abroad. Hard woods, hides, and small quantities of precious metals supply the major part of the remaining ten per cent. In the other five countries, the remaining exports comprise nearly the same list, but in different proportions. In most of them coffee occupies the leading place, while in Costa Rica bananas have risen to a point of equality with coffee, and bid fair soon to surpass it. The value of the coffee exports has remained nearly stationary during the last ten years; in 1896 it was £897,000, in 1905 only £786,000. Banana exports on the other hand, have grown with astonishing rapidity, from £117,000 in 1896 to £760,000 in 1905. The market for Central American bananas is extending rapidly, the last few years having seen large sales in England, and it is looked upon as certain that the success of the industry in Costa Rica will stimulate the development of the banana lands of the other five countries. The decline in the value of the coffee exports from Costa Rica has been more than offset by the increase in the banana exports, and the total value of the exports of all commodities to foreign countries has, therefore, increased from £1,110,000 in 1896 to £1,700,000 in 1905. And this growth in exports has naturally been accompanied by a development of the import trade through a general increase of the purchasing power, as well as through the increased demand for the materials needed by the expanding industries. The principal articles imported into Costa Rica are the following:—Textiles, food stuffs, iron and steel, paints, dyes, &c., chemicals and drugs, paper and manufactures thereof, tobacco, carts, carriages, &c., leather and wood.

CANADIAN CREAMERIES.

The Dominion Department of Agriculture undertook the management of creameries in Alberta in the year 1897. Previous to that year creameries had been established in Calgary, Edmonton, Innisfail, and Red Deer, but owing to some cause not disclosed, these creameries had not worked successfully. The management was assumed by the Government in the first place, because it was considered necessary to "nurse" the creameries for the first few years of their existence, in order to tide them over that difficult period of small output and consequent excessive cost of manufacture, on account of sparse settlement, and difficulty of carrying on the work in a newly settled territory. The Canadian Minister of Agriculture says that the Government operation at once established confidence in the business, and ensured the support and co-operation of the farmers in those districts. A number of these already established creameries received financial help from the Government in the shape of loans, or advances for the payment of the best and most improved machinery and equipment. This money was repaid to the Department of Agriculture by an assessment of one per cent. per pound on the butter made from year to year. The management of these creameries by the Department was continued much longer than it was intended when the work was begun in 1896-97. The Minister was induced to continue the work from year to year because it was contended that the withdrawal of Governmental interest would mean the ruin of many promising organisations by destroying the confidence which resulted in the communities by

reason of Governmental control and supervision. It was also true that many of the new settlers had had no previous experience in that industry. The conditions were new and untried. New problems had to be solved, and there were no records or precedents of years of successful operations under the prevailing conditions, as there were, and are now, in the older dairying districts. It can be asserted to-day that no districts in Canada have a better organised, better equipped, and more promising industry than has the creamery industry in the North-west at this moment, and which has been moulded out of what were, in 1897 and 1898, a few practically defunct and bankrupt businesses. Debts have been paid off, new buildings erected, new and first-class equipment installed, confidence established, enthusiasm kindled in the owner and worker, and large numbers of farms have been improved and stocked with cattle, while the returns from the creameries, at least as far north as Alberta, are making the foundations of the country's present prosperity. In the working of these creameries, the Government assumed full control, engaging the butter makers, providing all the necessary supplies, giving considerable personal attention to the workings, and assuming all responsibility for the quality of the butter and for the marketing of the same, keeping the factory books, &c. Provincial government having been granted to Alberta and Saskatchewan, the Dominion Government could not consistently continue the creamery industry, and at a meeting held at Edmonton in February last, the control and management of the industries in Alberta were transferred to the provincial Government. Since that date the Province of Saskatchewan has assumed the management and control of the Government creameries in that province, and practically all the money lent by the Dominion Government has been repaid to the Government, and the creameries are well equipped, valuable, and doing a very successful business, and have been a great factor in filling up, supporting, and making that new country prosperous and the farmer comfortable. In the autumn of 1896, the Dominion Government appropriated by legal enactment a sum to be expended by the Minister of Agriculture in assisting creameries in the North-west Territories, this fund to be advanced as a loan for the establishment of creameries. Some of the conditions were the following:—Joint-stock companies might organise and be assisted by the Government, the company to be duly incorporated, the company or association to provide suitable buildings, premises, and plenty of good water, buildings to be equipped and erected according to plans furnished by the Department of Agriculture; milk from not less than 400 cows to be guaranteed, situation and site of creamery to be approved, the Government to take the management of the creameries where loans are made for equipment, and to manufacture the butter for the owners at a charge of twopence per pound; the Government to pay advances to the owners after the end of every month of such sums as the Department may estimate to be two-thirds of the net value of the milk and cream supplied by them; the Government to charge one halfpenny per pound on butter in addition to the twopence for manfacture and sale, as a reserve or fund for the repayment of loan or advance, and an additional penny per pound for any debts that may have been upon the plant at the time the Government took charge of the same; that the Government shall control and manage the enterprise for at least three years unless the amount of the loan and advance is paid before that date, the Government to pay annually for rents and use of premises a sum not exceeding 7 per cent. of their value; when the loan or advance has been repaid the creamery may become the property of a joint-stock company, and pass from the direct centrol of the Government. These are the main features and conditions of the Government's management of the North-west creameries, which has been wonderfully successful, and most beneficial to both country and individual.

DEMAND FOR FURNITURE IN BAVARIA.

The native woods of the southern and central part of Europe in general, and the kingdom of Bavaria in particular, are limited in quantity and variety, and lack adaptability to furniture making, while all woods are very high in market value. Owing to this state of affairs, furniture in South Germany is extremely expensive. There is very little solid furniture made in the district of Munich, according to the American Consul-General in that city, practically all being veneered, and the veneer used is of poor quality, very thin and not durable. The natural result of the use of this thin veneer is that after a very little time it warps and cracks, and the furniture becomes valueless for ornamental purposes. Furniture dealers in and around Munich demand and obtain profits which seem incredible. The system of quick sales and small profits does not appeal to the more conservative Bavarian, who prefers to obtain a large profit on one sale, which causes him less trouble than a small profit on many sales, which latter, of course, would extend his business more rapidly than the former method. A feature which must at first be reckoned with is the system of long credits obtaining in Bavaria. It is the custom for the tradesman to send his customer's bills about every six months, and many firms send out their bills only in the new year. This system naturally causes a larger proportion of bad debts, and therefore increases the cost of the goods sold; but that the cash trading system can be introduced is indisputable, as has been proved by department stores selling for cash in the city of Munich, which by all appearances are doing a profitable trade. Munich, being the German art centre, it is not surprising to find that considerable value is placed upon the design of the furniture. For example, two suites of furniture, practically similar in material,

construction, &c., are placed together. The prospective customer asks the respective prices, and finds that one suite is from twenty to forty per cent. higher priced than the other. In explanation the dealer states that the more expensive suite is "designed by Professor A.," or "by the celebrated designer B." This applies, naturally, only to the better class of furniture, but it is inconceivable that a design of furniture, being apparently so costly, should be executed with such poor materials. There are trade combinations in Bavaria, but such combinations are formed, not with the idea of reducing the cost of production, but in order to keep prices above a stipulated minimum. This system abolishes all competition, as it is more in the interests of the trade to join such a combination than to suffer the disadvantages of an uphill fight against superior odds. The Consul-General says that undoubtedly the best method of introducing furniture would be in a suitably-placed showroom, where tastefully designed furniture of solid manufacture could be exhibited. The system of sending catalogues, which so many firms adopt, is very undesirable, as they are nearly always in the English language, of which the German dealer has usually no knowledge, and, further, it is most probable that these catalogues are put aside and forgotten. A showroom, as suggested, in charge of a smart business man, speaking German and understanding his trade, and the points of superiority over the German article, would, although being expensive at first, bring a greater volume of trade in one year than the system of sending catalogues and price lists would in ten. The existing prejudice in Bavaria against machine made furniture would easily be overcome when the people had the chance of examining the goods personally, with all their merits pointed out by an intelligent salesman.

CHICAGO MEAT EXPORTS.

Mr. Consul Finn's report on the trade of Chicago and its district was received at the Foreign Office on May 10th, so that it must have been compiled before the recent disclosures. In his references (No. 3622, Annual Series) to the meat trade, there is little to suggest the state of things since disclosed, although some of the Consul's figures give an inkling of the truth when carefully considered. The following tables which show the total exports of the articles named, and the proportion of them that came to the United Kingdom in 1905, illustrate not only the extent of the trade, but the large proportion of it which is with the United Kingdom :—

	Total value. £	United Kingdom. Value. £
Cattle	8,201,475	7,416,376
Hogs	162,383	6,096
Sheep	231,124	166,237
Horses	615,531	68,675
Mules	144,208	—

	Total Value. £	United Kingdom. Value £
Beef—		
Canned	1,484,614	927,849
Fresh	4,649,358	4,617,669
Salt and cured	853,354	242,764
Bacon	5,647,398	4,376,602
Ham	4,231,713	3,827,007
Pork	2,421,954	1,533,657
Mutton	10,447	—
Tallow	778,797	324,998
Lard	10,976,349	3,524,660

Mr. Finn says that "examination of the stock in the yards shows remarkably improved breeding and better care from year to year, but many farmers send their cattle to market in only a half-fed condition." "The class and condition of the hogs coming to market have," says Mr. Finn, "been very good, in marked contrast to the previous year," but a little further on in his report he says that "the health of swine has improved in that cholera has not been as bad as usual, but there has been a good deal of tuberculosis found in the carcases." The price for "canners"—a canner, as Mr. Finn explains, being "an animal with little, if any, fat on it, in fact, often nothing more than skin and bone"—ranges from 8s. to 10s. 9d. per 100 lbs., or an average of a trifle over a penny per pound, whilst inferior to fair "canning" cows average from 6s. $2\frac{1}{4}$d. to 7s. $2\frac{3}{4}$d. per 100 lbs., or a good deal less than a penny per pound, which suggests possibilities that are not reassuring.

OUTPUT OF ELECTRICAL MANUFACTURES IN THE UNITED STATES.

In connection with the quinquennial industrial censuses published in the United States, and which measure the total volume of internal trade, *the Electrical Review, N.Y.*, publishes the following figures as official. These figures indicate that there has been a substantial increase in this industry in the United States as compared with the statistics of 1900, which cover the fiscal years ending May 31st. Comparative figures for 1905 and 1900 are shown in the following summary :—

	1905.	1900.	Per cent. increase.
Number of establishments	783	580	35·0
Capital	$191,469,874	$83,130,943	130·3
Number of salaried officials, clerks, &c.	11,590	4,987	132·4
Salaries	$11,675,576	$4,563,112	155·9
Wage earners: average number	59,336	40,890	45·1
Wages	$31,226,721	$20,190,344	54·7
Miscellaneous expenses	$17,934,878	$6,788,314	164·2
Total cost of materials used	$66,728,176	$48,916,440	36·4
Total value of products*	$140,614,481	$91,348,889	53·9

* Exclusive of $17,335,033 reported as by-products of other industries, the aggregate value of electrical machinery and apparatus production for 1905 being $157,949,514.

The principal products are summarised as follows:—

	1905.	1900.	Per cent. increase.
	$	$	
Dynamos	11,084 234	10,472,576	5·8
Motors	22,370,626	19,505,504	14·7
Carbons	2,710 935	1,731,248	56 6
Incandescent lamps	8 319,159	4,036,112	106·1
Telephone and Telegraph apparatus	16,974,892	12,154,678	39·7
Insulated wires and cables	34,519,699	21,292,001	62·1
All other products	59,171,047	33 490,464	76·7
Custom work and repairing	2,798,922	2,063,736	35·6
	$157,949,514	$104,746,319	50·8

The only figures of the electrical industry which can be cited are those given in Garcke's Manual of Electrical Undertakings which indicate the position of the electrical industries in the United Kingdom, deal mainly with the capital invested, and are as follows:—

	1900.	1905.	Per cent. increase over 1900.
	£	£	
Manufacturing undertakings	25,990,600	40,324,671	55 1
Electricity supply undertakings (municipal and company-owned)	37,718,885	65,587,328	88 6
Electric traction undertakings (municipal and company-owned)	50,041,726	124,008,376	147·9

None of the above figures, however, embraces all the data required to afford an absolute summary. For instance, those dealing with manufacturing concerns only refer to limited liability undertakings, and therefore exclude a number of smaller private firms. On the other hand, they include a number of general engineering firms making boilers, engines, condensors, &c., mainly, but not wholly, for electric supply works. As regards electricity supply undertakings, private plants are excluded, and in regard to electric traction the capital outlay on electrification of steam railway systems on the North Eastern, Metropolitan and District, and Lancashire and Yorkshire railways is not included.

Concerning the spread of electricity for domestic and street lighting in the United Kingdom, the following figures are of interest:—Total lamps connected (8 c.p. equivalent)—1900, 10,436,019; 1905, 24,001,347; percentage increase over 1900, 120·8. In addition to this, the motor loads have increased to a tremendous extent, but no authoritative figures are available. An indication is seen in the following figures of the total number of Board of Trade units of electricity sold:—1900, 125,117,615; 1905, 533,594,315; percentage increase over 1900, 327·0. Although the moral to be drawn from these figures is inferential rather than direct, it seems a fair deduction to urge that the British electrical position generally has advanced at a greater rate than the same industry in the United States. The system of taking industrial censuses of the United Kingdom which the Government is about to introduce will afford a definite answer. In connection with this subject it may be mentioned that Mr. W. Pollard Digby, in his paper on the "Statistics of the World's Iron and Steel Industries," read before the Society in May, 1904, strongly urged the collection of statistics of internal trade.

TRADE WITH CHINA.

The various official reports recently issued with respect to foreign trade with China agree as to the growing antagonism of the Chinese authorities and people, and the consequent difficulties in the way of the expansion of this trade. Chinese unfriendliness to foreign commerce grows stronger with the outcry for the recovery of China's sovereign rights. To the officials and the upper classes, if not also to the larger traders, the purchase of foreign goods is a drain on China's resources, a diversion of the sources of gain to the pockets of outsiders; a bleeding of the rich body of China to be strenuously checked. This policy is not confined to foreign imports. It extends to all foreign employment in the development of China, and especially to the use of foreign capital for factories, mines, or railways. Its logical outcome would be the expulsion of everything foreign from the Empire. That trade must really be barter, that native capital is so inadequate even for ordinary trade purposes as to make interest high, and that to deplete the stock still further in order to put it into enterprise that can only mean a moderate return is indeed to bleed China, are statements quite as incredible to Young China, as that their claim to cancel concessions duly granted simply because the concessions prevent natives from engaging in unfamiliar enterprises is a sure way to ruin their country's credit abroad. The popular feeling, says Mr. Consul-General Fraser (No. 3578, Annual Series)—that is the feeling of the mass of the Chinese having some tincture of education of some sort—is that foreigners have taken advantage of China's incompetence to obtain undue influence for enriching themselves, and that now all treaties, agreements, undertakings, and precedents must be construed against the foreigner with the utmost strictness. This feeling is stimulated by the native press whose utterances read in a distorted form by the vast illiterate masses of the population, and whose tirades against the incompetence of former native statesmen, help the secret societies, anti-foreign and anti-dynastic, to increase their membership. With a Government hostile to its development and ready by remitting taxation on native companies to throw the burden of taxes on foreign trade, and an educated class eager to stop the supposed drain of native resources due to that trade, it would be strange if foreign trade showed

very rapid growth, even without the effect of the currency measures which have flooded the country with a debased coinage.

It must not, however, be assumed that either the import or export trade of China with foreign countries does not continue to grow. The returns for 1904—the latest available—show considerable expansion as compared with 1903, and Japan is improving her position in an especial degree. Her geographical position must always give her a great advantage in supplying the Chinese market, whilst national kinship and similarity in thought and custom particularly fit her people for penetrating into the interior and pushing their wares in their shops, and towns, and villages, whereas no one ever visits a treaty port. Their operations are greatly aided by Chinese partiality. For instance, Japanese hawkers have appeared in the streets of Wuchang, and the Japanese Post Office is about to open a branch there. Instead of the heated denunciations that such "invasions of the interior" would have called forth had the perpetrators been British or other foreigners, the native papers record that the police received strict orders to watch over these enterprising persons and laud the activity of the islanders in business. Thus while education appears to increase the old self-esteem and contempt for other outer peoples, the former dislike for the Japanese is transferred into keen admiration. The explanation doubtless lies in the leaven of students returned from Japan who aspire, but without success, to take the place of a Parliament and to express the views of the Chinese nation. Mr. Consul-General Fraser thinks that against these adverse influences every foreign nation will find it difficult to maintain the trade it possesses.

GERMAN TEXTILE INDUSTRY.

The new German tariffs providing among other things for the lowering of the import duties on cotton yarns, have caused considerable apprehension in German trade circles as it is feared that it may in time lead to serious competition of foreign yarns on German markets. It is also felt that the extension of old spinning mills and the building of new ones has recently proceeded at a rate which must sooner or later lead to serious congestion in the yarn market, even without foreign competition. It is estimated that compared with 1901 German cotton spindles have increased over 15 per cent., and, compared with 1893, as much as 60 per cent. According to the American Cousul at Kiel, the increase is much more pronounced in Westphalia, amounting to practically 32 per cent., and 160 per cent. on the same basis of comparison. During 1905 German cotton spinners did well, dividends increased, wages rose, and most of the mills improved their producing capacity. It is asserted, however, that for some time past, competition has increased, and the price of yarns has not maintained that profitable relation to the cost of raw material which was obtained last year. While, therefore, the increasing output has so far found ready sale, the profit margin has very much dimished. English competition has not, so far, been very formidable, but German spinners are asking themselves what will be their position if the English market, through decreasing cloth sales, is no longer able to absorb the growing yarn supplies. They apprehend that the German market will be swamped with English yarns competing with their own excessive supplies. England, however, is not the only country from which competition is feared. The Lodz Export Syndicate of Cotton Spinners, which was dissolved about a year ago, has been reconstituted, and is already offering yarns freely in Berlin and elsewhere. Austria is likewise making cheap yarn offers to German consumers, with the aid of export premiums provided for by the Austrian Spinners Syndicate. The textile manufacturers of Alsace-Lorraine report a successful period for the year 1905, and have orders booked ahead already which will keep them busy for some time. Early in March last a great strike commenced at Muhlhausen, where more than 5,000 workmen, employed at upwards of a dozen textile mills, went out, demanding an advance of 15 per cent. in wages and a ten-hour working day. A compromise was effected by which the workmen receive a 10 per cent. advance and the working day has been reduced one half-hour.

SUGAR BEET CULTIVATION IN SPAIN.

Sugar beets are cultivated in Spain mainly in Granada, Aragon, Asturias, and some parts of Castille. The land is generally well prepared in Granada and Aragon, not so well in Asturias, and rather badly in Castille. The method of cultivation is as follows:—The land is tilled to a depth varying from two and a-half inches to fourteen inches, and this done before winter sets in. In the spring it is harrowed and manure is distributed over the soil and covered. In sowing, the seeds are deposited in lines about fifteen inches apart. As soon as the plant has four leaves the picking out is done, leaving the best plants about ten inches apart, with ten plants to every square yard. When the soil begins to get dry the fields are ridged and watered. The land is kept clean of weeds, and the roots are pulled from five to six months after date of sowing. In some parts of Aragon small nursery gardens are made, and the roots transplanted into the fields in the month of June. The implements most commonly used for all operations are the spade, shovel, and the old Roman or Saxon plough. Some districts have begun to apply modern implements, mainly ploughs, cultivators, harrows, rollers, sowing drills, and distributors, which are used on the larger farms. The number of these is, as yet, limited, the implements most in use being the modern plough of the double Brabant type in the lighter sizes

HOME INDUSTRIES.

The Steel Trade.—The steel trade has not benefited from the San Francisco disasters as was expected. There have been few inquiries of any moment, and no orders of much consequence as the result of these disasters. For cement and other commodities there have been demands but not for iron and steel. The German manufacturers seem to be getting what British manufacturers hoped to get. It is understood that America has already contracted for a large quantity of German constructional steel, and that she will contract for a good deal more. The American output of steel bars and billets is insufficient to meet the present requirements of American steel manufacturers, and since at present they have their hands more than full American consumers are falling back on Germany as the next cheapest source of supply. That means larger orders to the United Kingdom for pig-iron but our steel manufacturers must look in other directions for new business, and they are likely to find it happily in orders from the Russian Government, and some of the South American Republics. It is rumoured that Russia intends to spend some £20,000,000 in the building of new warships if she can make the necessary financial arrangements, and a good deal of this expenditure may be expected to go into British pockets. The Russian shipyards cannot undertake the work, Americans would charge much more than our shipbuilders, neither France nor Germany could give such speedy delivery as the Clyde and the Tyne, and speedy delivery is among the first of the Russian requisites. Some of the South American Republics too want more ironclads, and are likely to come to this country for them. Apart from construction for foreign navies the outlook for new orders just now is not very promising. There is an over-supply of merchant craft afloat and on the stocks which cannot be absorbed except by an expansion in the world's commerce which may not come for some little time. But if some of the yards are engaged in building big and costly warships the temporary decline in shipbuilding that otherwise seems unavoidable may be averted. The building of a warship involves large and varied demands on the iron, steel, engineering and other industries, much larger and more varied requirements than the building of an ordinary steamer. Assuming a fair share of the Russian and South American warship orders come to this country it must mean a large consumption of iron and steel, and this at a time when the rebuilding of San Francisco has created an abnormal demand upon other sources of supply.

Pig-Iron.—The more America buys steel material from Germany the more Germany must buy pig-iron from the United Kingdom, since even at present her own furnaces cannot meet all her requirements. Last month the shipments of pig-iron to Germany showed a remarkable expansion. Our total exports of pig-iron in May were 148,637 tons as against 88,059 tons in the corresponding month of last year, an increase of 60,578 tons. Of this increase America took 4,798 tons, but the increase in the exports to Germany was no less than 14,426 tons if the shipments direct are taken, or 39,734 tons if those *viâ* Holland and Belgium are included.

Copper and Tin.—Twenty-five years ago the world's production of copper was 154,000 tons, at present it is over 700,000 tons, so that since 1880 it has more than quadrupled. In that year the world produced 38,000 tons of tin, during the last five years the output has averaged over 90,000 tons. The sources of supply in the case of copper have not varied greatly during the quarter of a century under notice, the United States of America producing a little over half the output, and Mexico and Spain coming next with about 11 and 9 per cent. respectively. With the tin output it is somewhat different. In 1880 the Straits Settlements, with Banca and Billiton, produced 54 per cent., and Cornwall and Australia each about 20 per cent. of the world's output. At present the Federated Malay States supply about half the output, Australia only 6 per cent., and Cornwall not much more than 5 per cent. Whilst the output of copper and tin has increased as stated, the demand has increased in larger proportion, and bids fair to get still further ahead of supplies, with the result that stocks have fallen off, especially in the case of tin, the output of which has not increased much of recent years, although we are constantly hearing of the discovery of new sources of supply in Africa, South America, and elsewhere. Is it likely that the production of copper and tin will be materially increased in the near future? The extension of electrical and other applications in which the use of tin in alloys cannot be dispensed with is certain to maintain and increase the demand for it, and the increase in the demand for copper will grow even more rapidly. But the sources of supply are more numerous and richer than of tin, though they do not promise any very rapid development. In Montana and Arizona it is estimated that the output will go on increasing for some years. Few of the mines have yet reached an appreciable depth in Arizona, which already produces about 100,000 tons of metallic copper per annum. In the Lake Superior district trouble is beginning to be experienced with some of the deep mines which makes estimates of probable output difficult. Some increase in the returns from Australia and South America may be expected, but it is not probable that the increase will be very large, nor is Spain likely to export more than she does at present. As to the tin output it is not easy to see where any great increase is to come from. The larger portion of the increased output of the last twenty years has been in the Malay States, but it is not likely to go on increasing. There are growing labour troubles, and the cultivation of coffee and rubber, more especially the latter, is more tempting. Some increase in the output of Bolivia and Australia may be looked for, but it is not likely to be large.

Perhaps Cornwall may come to the rescue. With better methods, more efficient management, and higher prices, the tin mining industry there ought soon to show considerable expansion. But the increased supplies of tin from all parts are not likely to be adequate to the increasing demands.

The Supply of Electricity.—In a contribution to the Engineers' Supplement of *The Times*, Mr. Garcke gives some remarkable figures with respect to the comparative output of electricity in New York and London. New York consumes nearly one thousand million units per annum, and London, with nearly double the population, not much over one quarter of that amount. It is the telephone over again. The consumption per head in New York appears to be 282 units against only 42 per head in London. The estimated requirements of London for electric power and traction apart from heating, lighting, and County Council tramways, is put by Mr. Garcke at 1,800 million units per annum. This requires a plant capable of dealing with a maximum load of 430,000 kilowatts, but the plant capacity proposed by the London County Council is only 60,000 kilowatts. Mr. Garcke suggests the acquisition and consolidation of all the London Electricity Supply Stations. Their total capital expenditure is about £17,000,000, and Mr. Garcke points out that as the capital of the Metropolitan Water Board is about £46,000,000, the problem is not nearly so vast as that which has been accomplished in the case of water supply.

The Growth of Assurance.—Although the growth of assurance has not been quite so rapid in the last quinquennial period as in the five years prior to the war with the Boers—being as 4 per cent. to 5—it shows a great advance upon that of twenty years ago. In 1886 the total annual premium income of the life offices was £15,845,000, which represented a sum per head of the population of £0·443. The annual premium income last year was £35,641,000, the sum paid for assurance per head being £0·833. That is a very remarkable advance, especially when the growth of taxation and of rates is remembered. In twenty years an increase of 19 per cent. in population has been attended by a growth of 125 per cent. in the sums paid for life assurance. The increase has been largely in "endowment" assurance," by which provision is made both for premature death and for old age. Whole-term-of-life policies are ceasing to attract, the public greatly preferring endowment assurances, a very natural preference. Since 1890 the increased sum covered by whole-term of-life policies has been £63,000,000 only, and during the last four years there has been practically no increase. On the other hand, the sum covered by endowment assurances of "ordinary" companies has been £171,000,000, and in the last four years the addition has been nearly £50,000,000. There has been a great increase in "industrial" business, that is to say, in policies averaging less than £10, upon which premiums are paid weekly or monthly. The growth in the sum assured by the industrial offices has been nearly £156,000,000, or 181 per cent. since 1890. Here again the endowment assurances are the most popular, the increase in them during the sixteen years being 384 per cent. as against 156 per cent. in whole-term-of-life policies. The professional and other classes take out endowment assurances to make provision for old age; the labouring classes, with little money to spend upon assurance, take out policies which assure them with the sums needed for funeral expenses. Industrial assurance is not, of course, provision against death or old age, and if we have regard to those other forms of assurance which cover these heads, it will be found that, great as has been the advance in the number of assurants during the last quarter of a century the proportion to the whole population is still lamentably small. If the industrial policies, which number 24,668,532, are excluded, the number issued is only 2,221,000, and many persons have more than one policy, so that it is safe to say that the number of persons assured is under 2,000,000. The *Statist* puts it as low as 1,600,000, which would mean less than four per cent. of the population assured in a form and for amounts which will so give material relief. Taking the men of the kingdom only, the *Statist* estimates that only about 1 in 7 possesses a policy which makes any real provision for his family. The great bulk of the middle and almost the whole of what is known as the labouring classes are uninsured save for such provision as superannuation funds may afford, and they seldom or never make provision for the widow, nor in the event of the premature death of her husband does she receive anything beyond the money actually paid by him to the superannuation fund, and usually, but not always, a small gratuity. These few facts and figures show that immense developments of insurance may be expected in the coming years.

CORRESPONDENCE.

I.R. AUSTRIAN EXHIBITION, 1906.

The Society of Arts have, ever since the Great Exhibition of 1851—which was in a great measure due to their efforts—shewn more than ordinary interest in everything relating to Exhibitions. I need not, therefore, doubt for a moment that an appeal which I venture to make to my co-members to give their kind support to the Imperial Royal Austrian Exhibition at Earl's-court will meet with a sympathetic reception.

I make this appeal not only because I am the prime mover and the commercial adviser of this national undertaking on the part of Austria, but also because I feel that I have rendered some service to the

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

MODERN WARSHIPS.

By Sir William White, K.C.B., F.R.S.

Lecture I.—Delivered January 29th, 1906.

At the request of the Council it is proposed in these lectures to describe in popular language the characteristic features of modern warships; materials and methods of construction; systems of armour protection and armament; improvements in propelling machinery and increase in speed; growth in dimensions and cost. The programme is extensive, it includes a great variety of subjects, many of which are highly technical. Consequently it will be possible in most cases only to indicate briefly the lines of advance, the causes which have produced rapid changes of type, the position attained at present, and the prospects for the immediate future. Not a few matters which will be dealt with involve serious differences of opinion amongst recognised authorities, even now that great naval actions in the Far East have furnished valuable information and taught many lessons. It will be my endeavour, therefore, to state these diverse opinions fairly, rather than to indicate my own views, believing, as I do, that it will be more useful and interesting to illustrate the difficulties of modern warship construction rather than to indicate the solutions which one may individually prefer.

First and most distinctive amongst the features of modern warships is the predominant influence exercised by the gun armament. Efficiency as a fighting machine is the *raison d'être* of every warship; the gun, by common consent, is admitted to be the supreme weapon of offence. Locomotive torpedoes have undoubted value in most, if not all, classes of warships, but their effective installation, protection, and working can be provided for without much disturbance of other requirements. As regards the guns, this is not true. From the commencement of a new design a definite decision is required in regard to their disposition in the ship, their arcs of command, the methods of manning and working and ammunition supply, the armour-protection to be provided for gun-stations and communications, and other points affecting fighting efficiency.

Modern warships are described commonly as "gun-carriages." That statement is true, but it conveys only half the truth. A modern warship is essentially a mobile gun-platform capable of transporting weapons of offence to any desired sphere of action, and of bringing them into play against an enemy. Her design is controlled considerably by the requirements laid down for heights of guns above water, for their relative positions, the necessities of ammunition supply, and the effects of "blast" when guns are fired. Magazines and shell-rooms must be situated so as to facilitate the supply of ammunition; and in the case of heavy guns the great weights of projectiles and ammunition require the storage to be immediately below the guns, so that the charges may be readily moved up to and loaded into the guns. In these and other senses a warship may be fairly described as a gun-carriage. The naval architect, however, while fulfilling all conditions essential to fighting efficiency has to associate with them no less important features, which are overlooked frequently when a ship is described as a "gun-carriage." He has to produce a structure possessing ample strength and stability, capable of meeting all conditions that may be encountered at sea, and of steaming at a desired speed over a stipulated distance. Safety, seaworthiness, and good behaviour must be ensured under conditions that cannot be determined with exactitude, as is the case with fixed engineering structures on land. A ship in a sea-way has to meet conditions that are unknown and incommensurable. In addition the designer has laid upon him the individual requirements of naval officers, marine and mechanical engineers and artillerists: each class naturally thinking its department the most important. These conflicting requirements have to be reconciled and combined in the best manner possible to the designer, who is expected to produce a vessel which, besides being a powerful fighting machine, shall be habitable, handy, and capable of floating when fully laden at a maximum draught of water, and shall be possessed of ample strength and stability. It is not an easy task at the best, and throughout its performance the paramount claims of the gun must be recognised.

Definite appropriation to special services of every cubic foot of internal capacity is a second characteristic feature of modern warships. In them there are no hold spaces available for cargo like the holds of merchant

ships. Whatever system of armour protection may be adopted, provision is necessarily made for a strong steel protective deck, virtually "roofing-in" the hold-space, and shielding from the effects of shot and shell the "vitals" of the ship—propelling machinery, boilers, steering engines, hydraulic or electrical auxiliary machinery, magazines, shell-rooms, submerged torpedo rooms, ammunition and other longitudinal passages essential to communications in action, submarine mines, and stores. "A place for everything and everything in its place" must be the motto of the warship designer if efficient working and minimum dimensions and cost are to be secured.

Closely associated with definite allocation of internal space comes a third characteristic feature: extremely minute subdivision into watertight compartments. Numerous compartments are formed primarily for purposes of stowage and accommodation, and it is obviously desirable to make the steel partitions between compartments watertight. This is now universally done in warship design, and, without inconvenience, watertight subdivision can be made much more minute than is possible in merchant ships. There is obviously a greater necessity for watertight subdivision, because warships are exposed to under-water attacks against which there is agreement that the best available protection is minuteness of subdivision. One feature is common to warships and merchant ships, namely, the use of cellular double bottoms formed by two watertight skins extending from bilge to bilge. Experience has proved that these double bottoms furnish valuable safeguards against accidents due to grounding, and in numerous cases vessels have been kept afloat by the inner skins when the outer skins had been so seriously damaged that the other watertight subdivision could not have saved the vessels from foundering. This cellular construction is, as a rule, carried to some height above the load water-line in modern warships, forming what are called "wing-spaces;" and in many vessels longitudinal wing-bulkheads are supplemented by other longitudinal bulkheads primarily built to enclose coal-bunkers, but made watertight and fitted with watertight doors. These arrangements are of value as defences against torpedoes and other under-water attacks. The minuteness of the subdivision in modern warships may be illustrated by the fact that 140 to 150 separate watertight compartments exist in vessels of large size. The construction of these compartments necessarily involves considerable cost in making partitions watertight and in fitting doors which can be readily closed when it is required to secure the watertightness of partitions in which openings are necessary for the ordinary working of the ships.

Attempts have been made repeatedly to avoid openings situated low down in the watertight bulkheads of warships and merchant ships, and to preserve the partitions intact. There is a period at which suggestions of the kind recur, generally with a freshness that ignores previous experience, and proceeds as if an entirely novel proposal had been made. So far as the naval architect is concerned the omission of such openings and the absence of watertight doors would be welcomed. It has been found, however, that the efficient working of steamships (both war and mercantile) practically demands facilities for longitudinal communication at a low level, in order that proper supervision of the machinery and boilers may be secured. In some cases where this condition was not originally fulfilled, openings have been subsequently made in bulkheads. Indeed there are other risks to be encountered in a great steamship than those relating to foundering; and serious dangers may arise if full control of propelling apparatus is not secured. The practical solution of these conflicting considerations has been found in fitting merchant steamers with apparatus by which all watertight doors can be speedily closed from a central station under the control of the officer in charge of navigation when any emergency arises. Similar arrangements have been made in some warships of other navies. In the Royal Navy, with numerous and highly disciplined crews, these mechanical controlling appliances have not been adopted. Reliance is placed upon regulations which provide that, under circumstances when danger of collision or under-water injury may arise, all doors shall be kept closed which are not necessary to efficient working, and that men shall be stationed at all the doors which are left open. Constant drill in closing watertight doors secures that all openings can be secured in a very short time. In the engine rooms and stokeholds many disciplined men are always at hand. Arrangements are fitted for closing doors from positions high up in the ships, as well as from the neighbourhood of the doors themselves. Under these conditions experience shows that, in case of accident and the entry of water into the

interior, openings in partitions can be efficiently dealt with and watertight subdivision made effective.

We are living in the "age of steel;" that is the principal material employed in the construction of warships, their armaments, armour, machinery, and many parts of their equipment. There are many qualities of steel in use, and the common name covers great varieties in strength and ductility. My predecessor in office, Sir Nathaniel Barnaby, introduced *mild steel* for the hulls of British warships in 1875, and entrusted to me the conduct of numerous experiments made with the new material. French naval constructors and steel makers had previously shown the way to us, but their lead was soon overtaken, and within a short time all the ships of the Royal Navy, except those of very small dimensions, were steel built. At first mild steel was somewhat dearer than the superior quality of iron previously in use for Admiralty work, but it soon became cheaper and its relative price has steadily fallen. Now iron is only used in a few merchant ships of small size and employed on special work.

Mild steel is from 25 to 30 per cent. stronger than the best iron used for shipbuilding; its ductility and working qualities are much superior, and its use secures large economies in the weights of hulls. All these economies, of course, tend to reduce the size and cost of vessels fulfilling certain conditions of design: or in a vessel of a certain displacement tonnage such economies enable a larger percentage of the total weight to be devoted to armour, armament, propelling apparatus, or fuel. Continual demands are made for increased powers of offence and defence, and for higher speeds, and the remarkable advances made during the last thirty years are largely the result of the use of steel instead of iron.

Improvements are continuously being made in steel manufacture; the alloys of iron with rarer metals—such as nickel, chromium, and aluminium—in association with extended knowledge of the possible effects of "heat-treatment," are enabling manufacturers to offer to engineers stronger and better material. Until recently, mild steel has satisfied the demands of shipbuilders, and its excellent qualities have ensured its almost universal employment. About thirty years ago, I suggested to the Landore Steel Company (of which the late Sir William Siemens was the head) the desirability of ascertaining whether steel of *stronger quality* could be produced in forms suitable for shipbuilding. The experiments then made showed that this was possible whenever the need should arise, the price of the stronger steel, of course, exceeding that of mild steel. At that time, mild steel sufficed for ordinary requirements. In a few special vessels, stronger steel was used (under precautions) to keep down weight; but the extensive use of stronger steel did not begin until about ten years ago, and by that time there were substantial advances in steel manufacture as compared with 1876. In my own practice, I found it advantageous to use stronger steel in certain portions of the structures of swift cruisers of large dimensions designed about 1895-6, wherein the forms and distribution of weights involved unusually large bending moments, while the nature of the armament interfered greatly with important structural arrangements. Strong steel was also used about the same time by builders of destroyers and torpedo vessels. Since this commencement was made, enlarged experience has given confidence in the stronger steels; their use is becoming general for warships, and has been sanctioned by Lloyd's Register of Shipping for merchant ships. One of the most notable examples of this important change of practice is found in the great Cunard turbine steamers now being built; stronger steel being used in many parts of the structures, especially in those subjected to severe tensile and compressive stresses. Both for warships and merchant ships the extended use of these higher qualities of steel may be anticipated, and further economies in structural weights will be obtained thereby. In Admiralty practice the stronger steel used is from 20 to 25 per cent. superior (in its limit of elastic strength) to mild steel, and the reduction in weight usually made is from 15 to 20 per cent. There are indications that for special vessels, in which increase in first cost may be justifiable because of gains in other directions, still stronger steel may be used with safety. In other words the limit of prospective improvement has not been reached, and the limit of reduction in scantlings will be determined, probably, by considerations of durability and provision against local straining or corrosion. This has already proved true with mild steel and iron; certain portions of the structures having reached a minimum of thickness determined by other requirements than strength. As a consequence the economy of structural weight does not follow strictly the increase in strength of the material used

in construction, and amateur designers are apt to overlook the fact.

The *structural arrangements*, as well as the general design of warships are influenced greatly by the requirements of armament and protection. Protection may be subdivided under two heads: first, that associated with the defence of armament and ammunition supply; second, that devoted to the defence of buoyancy and stability. These two groups are closely related, and in many instances are inter-dependent. A considerable percentage of the total weight and cost of a warship is devoted to defensive arrangements, except in the smallest classes; and in a subsequent lecture this will be illustrated fully. Our concern at present is with the influence of armour protection on structures; this is considerable even in the simplest cases—such as cruisers fitted with thick, curved protective decks, while it is much more marked in ships having vertical side - armour as well as protective decks. It is inevitable that structural arrangements must be specialised if they are to embody protection of buoyancy, stability, and armament. Methods that are well adapted to unarmoured warships or to merchant ships do not apply. As systems of protection are varied, structural arrangements must be changed, in order to economise weight while providing structural strength.

There is, of course, no monopoly of endeavours after economy of weight on the part of designers of warships. All naval architects desire and aim at the association of lightness with strength; but the inducements to continuous effort in this direction are probably greatest in warship design. These vessels are not subjected to the rough usage experienced by ordinary merchant ships; they are more carefully inspected, cleaned and painted, and are consequently less liable to corrosion from sea and bilge-water. Moreover, their extremely minute subdivision, and the local strength derived from the presence of protective materials over large areas of their sides and decks, favours the adoption of lighter scantlings in many parts of the hull proper. As a consequence, the structural arrangements of warships differ radically from, and are relatively lighter than, those commonly adopted for merchant ships. For example, the transverse frames (or ribs) are more widely spaced and lightly constructed; the plating on outer and inner bottoms is thinner; deck beams are not so massive, deck plating is lighter, and in manifold details structural weight is lessened in warships, while ample strength is provided. Consequently, the hulls of warships are relatively very light, and the percentage of the total weight (or displacement) assigned to the hull-proper in a warship is much less than the corresponding percentage of a merchant ship. Experience proves conclusively that under their conditions of service the relatively light hulls of warships furnish ample strength. Even in extreme cases, where vessels carrying enormous loads of armour, armament, propelling machinery, and fuel are placed in dry dock, or when they are subjected to severe stresses due to rolling and pitching at sea, all requirements are met. Instances of structural weakness in warships are rare; in nearly all cases where weakness has been displayed it has been of a local character and readily dealt with by a small expenditure of weight in the form of additional stiffening material. An example may illustrate the relative lightness of the hull-structures of warships as compared with merchant ships. Taking the total weight (or displacement) of a battleship fully laden, about 38 per cent. of that displacement is devoted to the hull, accessories and fittings: and only about one-half of that amount is in materials contributing directly to the structural strength. This light structure carries a load amounting in the aggregate to 62 per cent. of the displacement: of which about 30 per cent. is in the form of armour and protective decks, 17 per cent. in armament and equipment, and 15 per cent. in propelling machinery and coals. For a swift cruiser of the protected type about 38 per cent. of the displacement is devoted to hull, accessories and fittings, 16 per cent. to protection, 11 per cent. to armament and equipment, and 35 per cent. to propelling machinery and coals. For an armoured cruiser of modern type and high-speed the per-centages are about 39 per cent. for hull, accessories and fittings, 21 per cent. for protective armour and decks, 12 for armament and equipment, and 28 per cent. for propelling machinery and coals. These figures illustrate incidentally the varying distribution of the displacement tonnage—the capital of which the naval architect has to dispose—in different types of warships, that distribution being governed by the relative prominence given to speed, coal-endurance, armament, and protection. They are given here primarily to show the relative lightness of the hull in warships, and this will appear when it is stated that in swift merchant steamers about 45 to 50 per cent. of the total

load displacement is devoted to hull accessories and fittings. In other words, a swift cruiser has about 10 per cent. less of the displacement devoted to hull accessories and fittings, and available for offence, defence, or fuel supply, than is devoted to the same items in a passenger steamer of about equal length and speed, but of greater displacement.

It has been asserted that warships are too flimsily built, that they would shake themselves to pieces, that they would be lost inevitably if they grounded, and that it would be wiser to follow mercantile methods of construction. Experience has shown these predictions to be false. Lightly-built warships and cruisers have proved strong and durable, continuing on service for thirty or forty years, and passing into the obsolete list simply by lapse of time. Warships have gone ashore and sustained very extensive damage, but have been salved, repaired, and restored to active service. Swift cruisers have not shaken themselves to pieces, but have remained uninjured, although their propelling machinery has been relatively more powerful than that of any mail or passenger steamer. Facts of this kind have silenced prophets of evil; criticisms, formerly frequent, have now practically ceased; and designers of merchant ships have benefited in many ways by the bold initiative taken in the structural design of warships. This is as it should be, for warship designers have learnt much from mercantile practice in regard to both ships and machinery. Meanwhile economies in structural weight in warships have been of great advantage, enabling increase to be made in armament, protection, speed or coal-endurance, in vessels of given dimensions, or permitting given conditions of design to be realised in vessels of less size and cost.

Perfection and high finish in workmanship are essential with the lighter scantlings adopted in warships, and first cost on labour is thus increased. In many directions extra outlay is incurred during construction in order to reduce weights of material in positions not contributing sensibly to structural strength, or in obtaining from manufacturers steel castings and forgings of the forms best adapted to the association of strength with lightness. Expenditure in these directions is fully justified by the gains subsequently obtained during the long period of service of a warship, but it must be borne in mind when estimating her first cost.

Similar considerations apply to the weight and first cost of propelling apparatus in warships. It is much lighter in relation to power developed than the corresponding machinery in merchant ships. Comparisons between the two types are often vitiated by non-recognition of essential differences in the services of the two classes. Speaking broadly a merchant ship, especially one of high speed, is built to perform a definite service involving voyages of known distance between certain ports. Apart from the influence of variations in weather the vessel proceeds always at maximum speed and works under uniform conditions. In the design of the machinery this constancy of performance is kept in view; all working parts of the machinery are endowed with ample strength to withstand nearly uniform stresses, and it is considered advisable to provide a large margin of strength to ensure against danger of "break-down."

On the other hand, warships perform ordinary cruises at low speeds, although designed and equipped for high speeds. Consequently under ordinary conditions the engine power required is only a small percentage of the maximum. A battleship with engines capable of developing, say, 18,000 horse-power, or a cruiser with engines developing 30,000 horse-power at full power under ordinary circumstances, may need only 2,000 to 2,500 horse-power. Periodical trials of British warships are made at full power in order to ensure that everything is in good order, but the great differences between ordinary conditions and maximum performance necessarily involve difficulties in design and management of machinery which do not exist in passenger steamers; and make it most important to take all possible means for reducing the weight of propelling apparatus, while providing ample strength against maximum stresses on the several parts.

Progress in marine engineering has been largely due to the enterprise of private shipowners, shipbuilders, and marine engineers. War fleets have benefited greatly by mercantile experience and experiment. Increase in steam pressure, with consequent economy in coal consumption, has been peculiarly the work of the mercantile marine. On the other hand, the special conditions of warships have furnished valuable experience with quick-running engines of comparatively short stroke and less weight in proportion to power developed; and modern practice owes much to the bold—and on the whole successful—departures made in warships with new types of boilers

and novel details of engine design. This is especially true of the "express" type of engines fitted in torpedo boats, destroyers, and small swift cruisers. Progress has been due, in fact, to the independent work and mutual assistance of designers and makers of marine engines for all classes of ships. Not a few private firms have been leaders in both directions, and their practice has combined the production of propelling machinery for mercantile as well as for warships.

Warship practice has been much less governed by precedent in regard to the types of boilers employed. This is particularly true in regard to water-tube boilers. It is not proposed to discuss the policy which has been pursued in the Royal Navy, and which has resulted in the universal employment of water-tube boilers. It is worth notice, however, that the war fleets of the world, without exception, have now adopted water-tube boilers; and that extended experience in our own navy has amply justified the abandonment of the cylindrical type.

As illustrations of the relative lightness of propelling apparatus in warships it may be stated that, on the basis of the engine-power that can be developed for long periods continuously in a modern warship fitted with water-tube boilers, the propelling apparatus can produce about 9 horse-power per ton weight of machinery and boilers. In a first-class passenger steamer of the mercantile marine with cylindrical boilers, the corresponding development on a passage across the Atlantic would not exceed 6 to $6\frac{1}{2}$ horse-power per ton weight of propelling apparatus. The mercantile steamer would have some advantage of economy in coal consumption, but that advantage would be due in part to the uniform conditions under which she works. If warships were employed on regular services much greater economy of coal consumption could be obtained than is possible under service conditions with excessive variations between ordinary and maximum power.

Warships, moreover, are capable of developing much greater power and maintaining higher speeds for short periods, and they must be able to raise steam very quickly when required in emergencies. Both these conditions are met by the use of water-tube boilers, assisted by mechanical draught which increased the rate of combustion. As to the development of power for short periods—or "spurts"—it is found that an increase of fully one-third the power that is developed for continuous steaming over long periods, can be obtained for 8 hours. In the trials of the *Drake* class, for example, 31,000 horse-power was developed for 8 hours, with a speed of $24\frac{1}{9}$th knots, and about 23,000 for 30 hours, with a speed of $22\frac{1}{6}$th knots. These vessels have repeated these performances during their quarterly trials on service, with their own crews. The recent voyage of the Second Cruiser Squadron from New York to Gibraltar was made at the maximum speed which was permissible with the amount of coal which could be stowed, and proved to be 18·6 knots—a performance surpassing that of any warships. Had the trial been made under other conditions to determine the highest continuous sea-speed in fair weather, the result would have been something like $21\frac{1}{2}$ to 22 knots. This speed is remarkable, when it is considered that the *Drake* class is 100 feet shorter than the *Campania* or *Lucania*, and of 6,000 tons less displacement, while she has to carry about 4,000 tons of armour and armament, items to which there is nothing corresponding in the passenger steamer.

Another notable Trans-Atlantic voyage was that of the battleship *Renown*, which averaged over 15 knots from Bermuda to Plymouth, and still holds the record for sea-speed amongst battleships, although what she did could be accomplished by many other British battleships designed and built between 1894 and 1902 and now on service.

The operations of building and launching warships are in many respects adapted to their special structural arrangements, and consequently differ in detail from the corresponding operations for merchant ships. Armoured battleships and cruisers, for instance, are often kept on the building-slips until considerable weights of armour-plating have been fitted to their sides. Their weights when launched are consequently very great, and the lengths are moderate as compared with merchant steamships of the highest classes. The extremities of the warships are very finely formed, and that fact increases the difficulty of getting them safely afloat. Experience of centuries has, however, resulted in the establishment of certain simple rules by which the surface and slope of the launching-ways are regulated in proportion to the weight of the ship, and when these rules are observed the risk of accident becomes small. A ship-launch is a moving spectacle even to those who have repeatedly witnessed the operation,

and the launch of a warship especially appeals to the patriotic sentiment of spectators. Only those who have been responsible for that operation can understand the feeling of relief when the brief passage of the vessel down the ways is over and she is safely afloat.

ANNUAL GENERAL MEETING.

The Annual General Meeting for receiving the Report of the Council, and the Treasurers' Statement of Receipts and Payments, during the past year, and also for the Election of Officers, was held, in accordance with the By-laws, on Wednesday last, the 27th inst., at 4 p.m., SIR OWEN ROBERTS, M.A., D.C.L., F.S.A., Chairman of the Council, in the chair.

The SECRETARY read the notice convening the meeting, and the minutes of the last annual meeting.

The following candidates were proposed, ballotted for, and duly elected members of the Society:—

Babu, B. Chitti, Messrs. Parry and Co., Madras, India.

Baksh, Khan Sahib Shaikh Umar, Bawarná in Tahsil, Palampur, Kangra District, India.

Bennett, Miss Florence Emily, 115, Ebury-street, Eaton-square, S.W.

Bernays, Albert Evan, M.A., 3, Priory-road, Kew, Surrey.

Bevir, Edward Lawrence, Rue Mésangère, 2, Valence sur Rhone, France.

Brandt, Rev. L. E., Pietersburg, Transvaal, South Africa.

Bruce, Charles William, Resident Engineer, Rohilkund and Kumaon Railway, Budaun, U.P., India.

Buckland, Commander Virgoe, R.N.R., 26, Cadogan-place, S.W.

Church, Alfred, Cheyne-walk, Northampton.

Cook, Samuel Edwin, 3 Recreation-road, Tientsin, North China.

Cuthbert, Captain James Harold, D.S.O., J.P., Beaufront Castle, Hexham.

Darley-Hartley, Mrs. Harriet, 9, Lancaster-road, West Dulwich, S.E., and Cape Town, South Africa.

Fletcher, Joshua, Ellerslie, Alberta, Canada.

Hackett, Hon. J. W., M.L.C., LL.D., M.A., St. George's-terrace, Perth, West Australia.

Hamilton, E. H., The Arizona Smelting Company, Humboldt, Arizona, U.S.A.

Hardinge, Henry Malcolm, care of Commercial Bank of India, Limited, Rangoon, Burma.

Hellyer, Thomas Waterman, care of Messrs. Locke, Lancaster and Johnson, 94, Gracechurch-street, E.C.

Holmes, Frederic, Messrs. Hatton and Laws, Launceston, Tasmania.

Jeffries, Francis Joseph, Sylhet, Assam, India.

Johns, J. Harry, 26, North-parade, Penzance.

Juettner, Otto, M.D., Ph.D., 8, West 9th Street, Cincinnati, Ohio, U.S.A.

Klopp, George O. H., Assoc.M.Inst.C.E., 200, High Holborn, W.C.

Langenhoven, Cornelis Jakob, B.A., LL.B., Oudtshoorn, Cape Colony, South Africa.

Laws, William Henry, A.Inst.M.M., 21, Sophia-road, Singapore, Straits Settlements.

Mason, Alfred James, 58, Kensington-court, W.

Melitus, Paul Gregory, C.I.E., 46, Holland-park, W., and Dacca, Eastern Bengal, India.

Morris, Rev. William Meredith, B.A., F.R.Hist.S. Garth Parsonage, Maesteg, South Wales.

Murray, Edwin Somerville, Tawahi, Aden, Arabia.

Nash, Hon. John Brady, M.L.C., M.D., Macquarie-street, Sydney, New South Wales, Australia.

Norris-Newman, Lieut.-Col. Charles L. W. M., 94, Consular-road, Tientsin, North China.

O'Molony, Chidley Kearnan, J.P., Kiltanon-house, Kimberley, Cape Colony, South Africa.

Panzera, Lieut.-Col. Francis William, Dovercourt, Essex.

Parry, Frederick H., Sule Pagoda-road, Rangoon, Burma.

Pooniah, K., Pleader, Ongole, India.

Tata, D. J., 3, Whitehall-court, S.W.

Taylor, John Eldred, Spilsbury-house, Wilberforce-street, Freetown, Sierra Leone, West Africa.

Venkataramayya, D., "Kali Nidhi," Mallesvaram, Bangalore, India.

Vivian, Harry Houlton, J.P., Tregavethan, near Truro, Cornwall.

Vose, Seth Morton, Westminster Art Gallery, Providence, Rhode Island, U.S.A.

Wallace, H. Vincent, Nogales, Arizona, U.S.A.

Weale, J. A., Boundary-place, Liverpool.

Weir, Colonel John, The Waldorf-Astoria, New York City, U.S.A.

Williams, Miss Antonia, 6, Sloane-gardens, S.W.

Wilton, Ernest Colville Collins, C.M.G., Royal Societies' Club, St. James's-street, S.W.

The CHAIRMAN nominated Mr. H. W. Barrow and Mr. Charles Hansford scrutineers, and declared the ballot open.

The SECRETARY then read the following

REPORT OF COUNCIL.

I.—Ordinary Meetings.

In the Address with which according to custom the Chairman of the Council, Sir Owen Roberts, opened the business of the session, he dealt chiefly with the manner in which in mediæval times the various Guilds had promoted the advance of Arts, Manufactures, and Commerce, while in later times the same work had been taken up by the Society of Arts. He showed that there was much in common between the more ancient Institutions and the more modern one, and much that was very similar in the results of their labours.

In the first paper of the session Mr. Martin Duncan illustrated and described the various applications of the Cinematograph to scientific purposes, and showed its value in connection with civil engineering, anthropology, natural history, and physics.

At the second meeting Sir William Preece gave an account of the meeting which the British Association had held in South Africa in the summer of last year, and told the results of his own observations on the industries, economics, and general progress of South Africa.

The next paper was by Mr. Sigmund Stein on "The Manufacture of Sugar from British Grown Beet." Mr. Stein is known to be an enthusiastic advocate of the introduction into this country of beet and beet sugar, and he held out very hopeful promises of the practical results of such an industry. Lord Denbigh, who was in the chair, expressed the opinion, as one who had himself made careful practical experiments, that so far as experiments could show, it had been proved that beet could be grown in this country of a sufficiently good quality to enable people to treat it on a commercial scale. The difficulty at present was that the farmers were waiting until there was a factory to manufacture the sugar, and the capitalists were waiting until the farmers had produced a sufficient crop to make it worth while erecting a factory. The result of the discussion was that though some authorities were not prepared to go as far as Mr. Stein, the general impression was that the industry, if established in this country, ought to be capable of being carried on at a profit.

Members will not have forgotten the very interesting paper read last session by Baron Suyematsu on "The Ethics of Japan." At one of the December meetings a paper dealing with the more practical question of the Commerce and Industries of Japan was read by Mr. W. F. Mitchell, who had himself been associated with Japanese commerce for many years. His Excellency the Japanese Ambassador, Viscount Hayashi, was in the chair. The paper was a thoroughly comprehensive one, dealing in a summarised fashion with all the principal products, manufactures, industries, and exports of the country.

The last paper before the Christmas vacation was by the inventor of the Aërograph—Mr. C. L. Burdick. In 1894 Mr. Burdick read a paper before the Society describing what was then his new invention of the Air Brush. The object of the apparatus was by means of a jet of air carrying a fine spray of any suitable colour to retouch and finish photographic pictures, principally those taken on bromide paper. The apparatus proved remarkably successful for its intended purpose, and various other applications were found for it, which formed the subject of Mr. Burdick's second paper. The apparatus was found to be capable of application to the decoration of pottery and textiles, for which purpose it was stated to be used to a very considerable extent. The modifications in the original appliance, and its development from a hand machine to one requiring to be driven by power, were fully described in the paper.

The first paper after Christmas was on a subject which has at various times occupied the attention of the Society—the training and production of the voice. The subject was dealt with by Dr. William Arthur Aikin under the title of "The Scientific Aspects of Voice Development." Dr. Aikin is a grandnephew of the Arthur Aikin who held office as Secretary of the Society from 1816 to 1839, and did very much at the time for its advancement. The popular, yet practical, lectures of Mr. Arthur Aikin on various branches of Science and Industry may be said to have originated the practice of reading papers or delivering lectures at meetings of the Society, and so really to have led up to our ordinary and sectional meetings, as well as to the Cantor lectures. It would hardly be fair to Dr. William Aikin to attempt to summarise in a paragraph the principles which he inculcates in his paper, but those interested in the subject, who have not already done so, should certainly refer to the number of the Society's *Journal* in which it is to be found.

Another subject which has received its full share of attention from the Society of late

years is certainly that of Forestry, and it was dealt with once again by Dr. John Nisbet in his paper on "The Planting of Waste Lands for Profit." The reading of the paper, unfortunately in the absence of the author, brought out a very valuable discussion in which Mr. Stafford Howard, Sir Dietrich Brandis, and Dr. Somerville, as well as the Chairman, Mr. Henry J. Elwes, took part. In the opinion of these experts there seems some doubt as to whether there is so much waste land available as Dr. Nisbet thought; but they all seemed to appreciate the value of his contribution to this very important subject.

At the next meeting Mr. Thomas Adams in a paper on "The Garden City and the Cheap Cottage" discussed the various efforts which have been made, or proposed to be made, with a view of lessening the tendency of the population to crowd into great cities, and described especially the new attempt to found what is called a Garden City at Letchworth, and the exhibition of Cheap Cottages which was held there in the summer of last year in connection with the proposed City.

Members will naturally expect that while the present rapid advance in electric lighting continues, at least one paper will be devoted to the subject during the session. This year we had two—one by Mr. Leon Gaster and the second by Mr. J. N. Shoolbred later on in the session. Mr. Shoolbred's paper will be referred to in due course. Mr. Gaster described the most recent improvements in incandescent electric lamps, and laid much stress on the importance of getting the greatest efficiency out of the lamp by using the proper voltage, and by paying considerable attention to the renewal of the lamps when their efficiency begins to drop. The paper was illustrated by an extremely fine collection of modern incandescent lamps and arc lamps, including several of the new flaming lamps and some high-power incandescent lamps. Amongst other valuable matter, Mr. Gaster published the results of certain tests which were made by the National Physical Laboratory for the purpose of the paper, and for which readers may be referred to the text of the paper itself.

In his paper on "The Horseless Carriage," Mr. Claude Johnson gave a comprehensive history of the progress which has been made in automobile vehicles during the past twenty years, 1885-1905. Although in the early part of the last century considerable advance was made in mechanical locomotion, this was checked by railway rivalry and by legislation, and it was not until 1885 that the modern motor really came into being. Future historians of the subject will certainly find Mr. Johnson's paper of great value as a contemporary record of much which would probably be forgotten, unless a note of it had been taken at the time.

In 1885, Dr. Lankester read a paper on "The Development and Regulation of our Sea Fisheries," and very shortly afterwards the now well-known Marine Biological Laboratory at Plymouth was established. Mr. Walter Garstang's paper on "The Fisheries of the North Sea," was, to a very large extent, a record of the results which had been obtained by work commenced at Plymouth in 1885, and since carried on with great persistence and ability. Dr. Lankester, to whose initiative the movement in this country is distinctly due, was in the chair.

The two Addresses which, in 1898 and 1899, Sir John Wolfe-Barry delivered as Chairman of the Council, dealing as they did with London Traffic, and containing many important and original suggestions for its regulation and improvement, may be said to have drawn to the subject that public attention which resulted in the appointment of the Royal Commission which has lately reported. The present condition of this important topic was fully discussed in the able and suggestive paper read here by Captain G. S. C. Swinton, L.C.C., and the value of the paper was enhanced by some very practical remarks by the Chairman, Sir John Wolfe-Barry, who referred to his own addresses, and added something to the information which they contained.

Mr. J. C. Dollman, in his paper on "Art in Painting and Photography," brought out the salient points in the discussion which has been carried on ever since the invention of Photography as to its pictorial capabilities, and the rivalry between the man with the camera and the man with the brush.

Mr. Geoffrey Drage dealt with a very large and important subject in his paper on "Imperial Organisation from a Business Point of View," and started a valuable discussion in which the Right. Hon. Alfred Lyttelton, who was in the chair, Sir Frederick Pollock, and Dr. Parkin took part.

Although the Society has had many papers and courses of lectures on the subject of mechanical propulsion on common roads, the application of the internal combustion engine to marine propulsion had not re-

ceived any attention here (except the passing reference in the admirable course of Cantor Lectures delivered last session by Mr. Dugald Clerk) prior to the paper by Mr. Bernard Redwood on "Motor Boats." As is well known, the motor boat is rapidly coming into extensive use and popularity, and Mr. Redwood's excellent paper will have proved of considerable interest to the many yachtsmen and others who are making use, or thinking of making use, of motor boats.

Mr. A. J. Martin, in his paper on "Coal Conservation, Power Transmission, and Smoke Prevention," after touching upon the coal supply questien, went on to consider the various methods of transmitting power, and as the result of a comprehensive survey was rather in favour of the transmission of coal gas in pipe lines.

In her paper on "Ramie and its Possibilities" Mrs. Ernest Hart claimed to have solved the problem of spinning and weaving this material, so that she was able to produce a very varied collection of textile materials made from Ramie, all manufactured on a commercial scale. It is to be hoped that further experience will justify her anticipations, for there can be no doubt of the value of such an industry, if it can once be placed upon a solid footing.

"The Production and Collection of Picture Postcards," by Mr. Frederic T. Corkett, a member of the firm of Raphael Tuck and Sons, who have certainly done more than any other publishers to promote the popularity of the picture postcard, gave an account of its origin, present characteristics, and the manner of its production.

For some years past Mr. J. B. Millet has been engaged in America in perfecting a system of submarine signalling, by which it is hoped that vessels approaching harbours, lightships, &c., may in future be able to locate their own position and the direction of the harbour by means of sound signals. The signal itself is given by means of a bell, the difficulty throughout having been to devise an apparatus by which the direction of the sound could be accurately located. This Mr. Millet appears to have done, and his statements are corroborated by the testimony of captains of ocean steamers and others who have made actual use of the system. It appears quite certain that a ship approaching, say the port of Liverpool, in a fog could make her way up the Mersey by means of signalling stations properly equipped with as much ease and security as if she were guided at night by the ordinary lights.

The use of caissons in bridge-building and for sub-aqueous tunnelling has of recent years considerably increased, and the natural result of this has been to draw greater attention to the cases of illness which have been produced in those working in compressed air for considerable periods of time. Professor Thomas Oliver has made a special study of this subject, and his paper upon it contained a great deal which was certainly new to engineers, and possibly to many medical men also, except any who may have had their special attention directed to the matter.

The subject of Watermarks gave Mr. Clayton Beadle the opportunity of reading a very interesting paper dealing with Watermarks, old and new, the method of their production, their origin, and their use. Mr. Beadle described the very ingenious devices by which the difficulty of producing watermarks in machine-made paper, long existent, has now been overcome.

The last paper of the session was read by Mr. J. N. Shoolbred, whose paper in 1878 was the first of the long series devoted to electric lighting. Mr. Shoolbred advocated for the general supply of electricity the establishment of Boards or Trusts, such as the well-known Mersey Harbour Board, in preference to the present system under which the supply of electricity is left to be dealt with by ordinary private companies.

In all, the Society has held 63 meetings this session. Of these, 39 were for the reading and discussion of papers, 23 being Ordinary Meetings, and 16 sectional (6 each Indian and Applied Art, 4 Colonial). There were also 24 meetings at which Lectures were given—19 Cantor, 3 Howard, and 2 Juvenile.

II.—Indian Section.

The thirty-eighth session of the Indian Section was opened with a paper by Sir James Bourdillon, who dealt with the partition, or, as he designated it, the reconstitution of Bengal. Though generally approving a measure by which India has been given a new province almost equalling in size and population the kingdom of Italy, Sir James Bourdillon rather questions the transfer of the entire Rajshahi division, and thinks more consideration might have been shown to the views of the opponents of the scheme. He does not believe that the division of Bengali-speaking people is calcu-

lated to destroy the feeling of national unity "which has of late years been sedulously developed among the educated classes of India," and he points out that sooner or later some remodelling of the huge unwieldy province was inevitable. Lord George Hamilton, who presided, observed in the course of an important speech that every Lieutenant-Governor of Bengal he had known was obliged to admit that the work he had to perform was "an almost undue strain upon his strength." One of the Lieutenant-Governors alluded to, Sir Charles Elliott, joined in a useful discussion and testified from his experience to the difficulty of one man ruling a province numbering upwards of 78,000,000 souls. The impartial manner in which the subject was treated by Sir J. Bourdillon and by all who spoke afterwards has been widely recognised.

At the Oriental Congress held in Vienna in 1886 a resolution was adopted urging the Government of India to undertake a deliberate and systematic survey of the languages of that polyglot country. The request was favourably received, as such requests usually are by the Indian authorities, but, owing to financial reasons, operations could not be started at once. In 1894 the preliminary details were settled, and under the direction of a distinguished member of the Bengal Civil Service, Dr. G. A. Grierson, the work was entered upon. The editing and collating of the enormous mass of linguistic specimens collected by willing assistants in all parts of the area of the Survey—practically the whole of India with the exception of Burma, Madras, Hyderabad and Mysore—were commenced in 1898. In due course several volumes appeared; more are in the press; and Dr. Grierson, in the paper he read on March 15 was able to announce that his monumental labours are now within a measurable distance of completion. Of the magnitude of the Survey some idea may be formed from the fact that reports have been made to Dr. Grierson on 231 languages (since reduced by elimination to 147) and 774 dialects. Apart from the gain that is likely to accrue to the science of language from the rich mine of materials now placed at its disposal, it is hoped that Western scholars will be induced to investigate the hitherto neglected literatures of the modern vernaculars.

In a paper on "Seistan," Sir Henry McMahon gave an account of the past history and present condition of a once famous country that after centuries of oblivion is again coming into prominence. Ten years ago Seistan in its isolation was separated from India by 500 miles of trackless waste. To-day a well-defined road traverses the intervening desert, while for 100 miles of the distance there is communication by railway. At the capital of Seistan, Nasratabad, there are now establishod British and Russian Consulates, a Custom House "under Belgian officers," and two banks, one British, and the other Russian. The population is in these days sparse, but if there be any who question Seistan's importance, politically, commercially, and strategically, to Persia, Afghanistan, and India, Sir H. McMahon recommends them to study the history of Russian endeavours to forestall us in that region.

Another valuable paper, and one in a sense complementary to that of Sir H. McMahon, was read by Major P. Molesworth Sykes, whose theme was "The Parsis of Persia," a remnant of whom numbering not much more than 10,000 all told, "still cling to the ancient faith as taught by Zarathushtra or Zoroaster," who is believed to have flourished in the seventh century before Christ, and shortly before the rise of Cyrus the Great. Thanks largely to representations of the Indian Parsis and to British protection the Persian Zoroastrian is not now actively persecuted, but he is subject to certain disabilities, and educationally is in a backward state. In concluding his paper the author appealed to the well-known generosity of the philanthropic Parsis of Bombay to provide additional funds for the amelioration of the hard lot of their less fortunate co-religionists in Iran. This appeal was cordially supported by Lord Curzon of Kedleston (who occupied the chair on the occasion), and before the meeting separated it was intimated that one of the many Parsis in the room was prepared to pay Major Sykes £500 towards the object in view.

To the series of papers on the provinces and cities of India an addition was made by Mr. C. E. Buckland, whose subject was Calcutta, which he described as not only the second largest city in the British Empire, but "a European city in an Indian environment," and a testimony to the capacity of the Anglo-Saxon race for colonisation and Empire. "British trade," he pointed out, "is and has ever been the dominant element in Calcutta. Native trade has, of course, contributed its share, but the native element has not been so prominent in Calcutta trade as it has been in Bombay."

Mr. R. B. Buckley, in a valuable paper on the

waterways of India, showed that the irrigation canals in that country are about 12,000 miles in length, and of these nearly 3,000 are navigable. Some purely navigation canals have been constructed in Bengal, Madras, and Lower Burma, at a cost of about £1,500,000. But the total sum spent on water communication in the peninsula during the past 30 years was only £5,000,000, whereas France, to mention only one instance, has expended in the same period six or seven times that amount, and is contemplating a further outlay of £20,000,000. It is apparently now being recognised in India that there is room for both waterways and railways, and interest in the former is reviving. In the circumstances, Mr. Buckley's paper and the discussion which it evoked are welcomed by commercial centres like Calcutta as calculated to help them materially in their efforts to bring about a more liberal policy in regard to inland navigation.

III.—Colonial Section.

For the fifth year in succession the programme of the Colonial Section has included a paper relating to Canada. The author on this occasion was the Hon. Rodolphe Lemieux, late Solicitor-General for the Dominion and now a member of Sir Wilfrid Laurier's Cabinet, and the title of the paper "Glimpses of French Canada." With reference to the origin of our French Canadian fellow-subjects, he mentioned that the prevailing type to-day is Norman, and he characterised as a "base calumny" the statement of some historians that the early immigrants were criminals discharged from the prisons of France. While the French Canadian is "deeply attached" to the religion and language of his ancestors, "he has," Mr. Lemieux says, "no connection except intellectually speaking, and that in a qualified way, with France." His country is Canada and all his traditions are Canadian, while his loyalty to the Crown is none the less actual and sincere because, not having had the same training as his fellow-citizen of English origin, he does not respond with the same fervour to such a scheme as that of Imperial Federation. Lord Strathcona, who presided, testified to the share taken by French Canadians in the remarkable development of the Dominion, and the Duke of Argyll, as a former Governor-General of Canada, also spoke favourably of the countrymen of Montcalm.

A paper on "Imperial Immigration" by Mr. Octavius C. Beale, a distinguished visitor from Sydney, dealt mainly with the attractions offered by his own part of the Empire to immigrants and with its "stupendous potentialities" in agricultural, pastoral and mining pursuits. What it seems Australia most needs are the "immigration of manufacturers" and the production of iron and steel from her own ores. "Australia compared with Canada," Mr. Beale says, "has but two-thirds the number of inhabitants yet our population has increased decade by decade up to the present in a higher ratio than Canada's. In productivity Australia is far ahead of Canada . . . . But where Canada excels Australia is in the highly important field of manufacture, of developmental production."

The Hon. J. G. Jenkins in a tersely written paper on "Social Conditions in Australia" also referred, though less directly, to the all-important question of immigration, and presented future colonists with a pleasing enumeration of some of Australia's advantages as a place of residence. "The death-rate is lower, the primary production is greater, the wages are higher, the standard of living is better, the houses are more substantial and surrounded with more land, the hours of labour are shorter, telegraphic communication is cheaper, the weather is brighter, the laws more liberal, the wealth more evenly distributed and class distinctions fewer than in almost any other country."

Finally, Sir Nevile Lubbock discussed some West Indian questions at present attracting public attention, including inter-colonial federation, federation with Canada, the preferential treatment given to the distilling interest of this country as against the West Indian rum producers, and the satisfactory effect on the prosperity of the islands of the abolition of sugar bounties. Sir David Barbour, who took part in the discussion, agreed with the author of the paper in thinking federation under a Governor or Governor-General as beyond the region of practical politics. He also doubted the possibility of amalgamation with Canada.

IV.—Applied Art Section.

The meetings of the Section commenced on December 12 with a paper on "Historical Pageants," by Mr. Louis N. Parker, who gave a vivid account of the scholarly historical pageant which he produced at Sherborne in the summer of 1905. The paper was illustrated by lantern slides of the chief incidents of the pageant, and by means

of the Urban Bioscope the whole procession was made to pass before the eyes of the audience. The pageant at Sherborne was the first of a series to be carried out in successive years, in which local incidents in the history of England will be represented in certain important towns. The pageant at Warwick will take place next month.

Professor J. M. Thomson, F.R.S., read a paper at the January meeting on "The Chemistry of Artists' Colours in Relation to their Composition and Permanency," a subject of great practical interest which has been previously dealt with in papers read before the Society and in Cantor Lectures by Mr. Holman Hunt, Principal Laurie, and Professor Thomson himself. In this paper Professor Thomson devoted his attention specially to the question of the permanency of the colours, and contributed a valuable series of tables of the composition and qualities of the various pigments.

A paper on "Some Illustrated Manuscripts of Continental Europe" was read by Mr. H. Yates Thompson at the February meeting. The paper was illustrated by a fine series of lantern slides, and Mr. Thompson gave in his paper an interesting account of how one of his manuscripts, a fifteenth century French translation of Josephus—was discovered to be a second volume which had been separated for many years from the first volume in the National Library of France. This second volume wanted twelve leaves of miniatures, ten of which were subsequently found in an album in the King's Library at Windsor Castle. The King desired that these miniatures should be replaced in the volume which Mr. Thompson wished to return to its original home in France, so that it might stand by the side of the first volume from which it had so long been separated. Shortly after the reading of this paper His Majesty himself handed over the volume to the French President.

On March 20th Mr. Cyril Davenport read a paper on "English Royal Heraldry," founded on examples from old seals and historical bindings. In this was shown the value of the historical evidence relating to the changes in the coats of arms of our several sovereigns and their supporters which are to be found in seals and book-bindings. The subject was fully illustrated by finely coloured lantern slides.

In his paper on "Damascening and the Inlaying and Blending of Metals" Mr. Sherard Cowper-Coles presented an historical account of the various processes of Damascening, Niello, &c., and then proceeded to describe his new process of ornamenting metallic substances. A demonstration of the process took place at the meeting, and a large number of specimens were exhibited.

The last meeting of the session, on May 27th, was held at the Whitefriars Glass Works, when Mr. Harry Powell read a paper on "Cut Glass," in which he traced the history of the art, especially in this country, and explained the various processes of glass-cutting afterwards shown in operation in the workshop.

V.—Cantor Lectures.

All the courses of Cantor lectures during the past session have been well attended. For some years past the Council have made a practice, at all events with regard to these courses of lectures which are of a technical character, of issuing tickets to students, while endeavouring to safeguard the interests of members by restricting the issue to those who are likely to profit by the educational advantages afforded by these lectures. It is certain that a good many young engineers have learned much from the courses on electricity and other branches of engineering which have been delivered of recent years, while the same remark applies to the lectures dealing with branches of applied chemistry and other similar subjects. It is probable that members do not fully avail themselves of their privilege of giving admission to these lectures to young students, and the Council think it quite worth while to draw their attention to the fact. That the heads of the various Technical Institutions in London are fully aware of the advantages to be obtained is shown by the number of applications which are always made for students' tickets, and there must be many others known to members of the Society who would benefit educationally by attending lectures given by the highest authorities on their respective subjects.

The first course for the year was given by Professor J. A. Fleming, his subject being "The Measurement of High Frequency Currents and Electric Waves." This course was in continuation and completion of the two previous courses on "Electric Oscillations and Electric Waves" and "Hertzian Wave Telegraphy." These three courses of lectures perhaps form the best account of the origin and progress of Wireless Telegraphy which has yet been published, and they form the

basis of Professor Fleming's recently issued work on "The Principles of Electric Wave Telegraphy." As was the case with the previous courses, these lectures were very fully illustrated by experiments, the chief feature of this course being the demonstration of the usefulness of the very beautiful instrument which, under the title of the Cymometer, Professor Fleming has invented for the measurement of electric waves.

For the second course of lectures the Council were fortunate in securing the services of Sir William White, who gave five lectures on "Modern Warships." These lectures covered in a popular, but thoroughly practical fashion, the whole range of construction of the modern warship, its protection and its armament. This subject, always of the highest national importance, has recently attracted a more than usual share of public attention, and the lectures were very fully appreciated by large and attentive audiences.

The same remark applies to Professor Vivian Lewes's course of lectures on "Fire: Fire Risks and Fire Extinction," which was the third course of the session. Professor Lewes is well known to Society of Arts audiences, and they have always appreciated the admirable manner in which his lectures are experimentally illustrated. The present course, commencing with a lecture on fire and combustion, went on to deal with the causes of fires, and the prevention of fire by methods of fireproofing and fire extinction.

The fourth course was by Mr. Alfred Maskell on Ivory, and dealt with the sources of the material, its industrial uses, and its artistic applications. Mr. Maskell has recently published an elaborate work on the subject in which the artistic applications of ivory were dealt with at considerable length. The present course may be looked upon to some extent as supplementing his book, by treating a little more fully on the practical uses to which the material is put.

The fifth, and last, course was by Mr. G. W. Eve, on the subject of "Heraldry in Relation to the Applied Arts." Heraldry, though it has come to be regarded as a matter mainly of antiquarian interest, forms really a very important element in decorative design. Artists have continually to make use of it in their design; it is of importance that they should do so without offending against its laws; and the main object of Mr. Eve's lectures was to put them in the way of knowledge enough to prevent their falling into the errors commonly made in the heraldic decoration of the present day.

The courses of Cantor Lectures next session will include the following:—1. A course by Mr. A. D. Hall, Director of the Rothamsted Experimental Station, on "Artificial Fertilizers." 2. A course by Professor J. W. Gregory, D.Sc., F.R.S., on "Gold Mining and Gold Production." 3. A course by Professor Herbert Jackson (Junior Professor of Chemistry at King's College), on "Detergents and Bleaching Agents used in Laundry Work." 4. A course by Mr. F. Hamilton Jackson, on "Romanesque Ornament."

VI.—Howard Lectures.

Under the Will of Thomas Howard (1868) the Society holds a sum of £500 for the purpose of "presenting periodically a prize or medal to the author of a treatise on the properties of steam generally, or any of them particularly, as applied to motive power, or it may be of air or permanent gases, or vapours, or other agents so applied, or to the inventor of some new and valuable process relating thereto."

The offers made under this trust of prizes of £100 for essays, not having produced any satisfactory result, the Council, in 1884, came to the conclusion that the best way of carrying into effect the wishes of the testator would be to arrange for the delivery under this trust of series of lectures on some subject dealing with motive power, which might, after their delivery, form a text-book on the subject. They have therefore from time to time, as the accumulated funds permitted, arranged for courses of Howard Lectures, dealing with subjects which seemed to be comprised within the terms of the bequest. Four such courses had already been delivered:—"The Conversion of Heat into Useful Work," by William Anderson, M.Inst.C.E. (1884); "The Development and Transmission of Power from Central Stations," by Prof. W. Cawthorne Unwin, F.R.S. (1893); "Mechanical Production of Cold," by Prof. J. A. Ewing, F.R.S. (1897); "Polyphase Electric Working," by Alfred C. Eborall, M.I.E.E. (1901). The success of the scheme has justified the Council in continuing it, and they accordingly invited Professor Silvanus P. Thomson, D.Sc., F.R.S., to give a course of three lectures on "High Speed Electric Machinery, with special reference to Steam-turbine Machines," a subject which appeared to be specially appropriate at the present time, since the extended use of steam-turbines has

called for a corresponding development of dynamos capable of running at a high speed.

The lectures were delivered in January and February, and were well attended, a large number of students availing themselves of the opportunity of hearing from one who has devoted much time and thought to the investigation of a difficult and complicated subject the latest results of his researches.

The Howard Trust being only a small one (£500) it cannot be expected that the lectures given under it can form so full or complete a series as the Cantor Lectures, but as it deals with a limited subject, while the Cantor bequest is quite unfettered, it may be anticipated that as time goes on this application of its funds may produce a number of text-books of value equivalent to the long series of lectures delivered under the trust established by Dr. Cantor's legacy in 1863.

VII.—Juvenile Lectures.

The Juvenile Lectures which were given last Christmas time were by Professor Herbert Jackson, who took for his subject "Combustion and Flame." The lectures were of course of a thoroughly elementary character, and were copiously illustrated throughout with experiments. The nature of combustion, the combination of other substances with oxygen, attended with the evolution of heat and light, were explained, and numerous other instances of chemical combinations in which heat and light were produced were given. The nature of flame was explained, and the causes of the luminosity of flame were dealt with. The real nature of luminosity led to an interesting series of experiments intended to show that luminosity merely arose from the stoppage by particles of a complex character of molecular oscillations, too rapid to give impressions to our eyes, and that to render a flame luminous it was necessary to provide such complex particles capable of converting into visible oscillations the extremely rapid invisible oscillations of the flame.

VIII.—Albert Medal.

The Albert Medal for the present year has been awarded, with the approval of His Royal Highness the President, to Sir Joseph Wilson Swan, D.Sc., F.R.S., "For the important part he took in the invention of the incandescent electric lamp, and for his invention of the carbon process of photographic printing." Sir Joseph Swan's earliest published scientific work was in connection with Photography. It was in the year 1864 that he took out his patent for producing photographic prints in carbon. The invention was based on the fact that a mixture of gelatine with the dichromate of an alkali is hardened and rendered insoluble by light. Mungo Ponton (1839), Poitevin (1855) and others tried, without much success, to utilise this discovery. Swan mixed pigment with the dichromated gelatine, and coated a surface with it. After drying and exposing the film behind a negative he removed the support on which it lay, and washed away from the back of the film all the gelatine and pigment which had not been rendered insoluble and so produced a print. Later by the introduction of temporary supports for the development of the print the process was further simplified and became popular under the name of Autotype. Despite the great advances of photography and the many new methods invented for photographic printing, it remains in its own line without a rival at the present day. The great merit of the process was that it was absolutely permanent, a most important quality at that time when the only other known method of photographic printing was by means of albumenised paper rendered sensitive by a salt of silver. The results of the silver process, beautiful as they are, are comparatively fugitive, and the invention of a method for permanent photographic printing was of the very highest importance.

About the same period Mr. Swan was experimenting in electricity, and in 1860 he made a lamp with a carbon filament enclosed in a vacuous receiver. The electric current was obtained from a Grove battery. In 1880 he took out his first patent for an incandescent lamp. In it he proposed to employ a Sprengel air-pump to obtain a better vacuum than had hitherto been possible in the globes used for incandescent lamps. He was also the first who used a filament of parchmentised celluloid, which is practically the same material as is now employed, and he later devised the method at present in use for the production of carbon filaments by squeezing a viscous mixture through an orifice. It is well known that Mr. Edison was working in America at the same time and in the same direction. The question of the absolute priority of the two inventors was never actually decided, because the two, to avoid litigation, united their forces, and came to an agreement as to the commercial production of incandescent lamps. Sir Joseph Swan is also responsible for other

electrical and photographic inventions, some of considerable value.

IX.—Medals.

Amongst the readers of papers during the past Session there were two Members of the Council. At one of the Ordinary Meetings Sir William H. Preece read a paper on "The British Association in South Africa," and in the Applied Art Section, Professor J. M. Thomson read a paper on the "Chemistry of Artists' Colours in Relation to their Composition and Permanency."

According to the usual practice, medals were not awarded for these papers, but the Council have had pleasure in acknowledging their merit by passing a vote of thanks to their authors.

The Council have awarded the Society's Silver Medal to the following readers of Papers during the Session 1905-6:—

At the Ordinary Meetings:—

To Mr. W. F. Mitchell, for his paper on "The Commerce and Industries of Japan."

To Dr. William Arthur Aikin, for his paper on "The Scientific Aspects of Voice Development."

To Mr. Leon Gaster, A.M.I.E.E., for his paper on "Progress in Electric Lighting."

To Mr. Walter Garstang, M.A., for his paper on "The Fisheries of the North Sea and the Bearings of Recent Investigations upon the Problems of Supply."

To Captain G. S. C. Swinton, for his paper on "London Traffic."

To Mr. Bernard B. Redwood, B.A., for his paper on "Motor Boats."

To Mr. J. B. Millet, for his paper on "Submarine Signalling."

To Professor Thomas Oliver, M.A., M.D., LL.D., for his paper on "Bridge Building by means of Caissons, including remarks upon Compressed Air Illness."

To Mr. Clayton Beadle, for his paper on "The Development of Watermarking in Handmade and Machine-made Papers."

In the Indian Section:—

To Sir James A. Bourdillon, K.C.S I., for his paper on "The Partition of Bengal."

To Dr. George A. Grierson, C.I.E., Ph.D., D.Lit., for his paper on "The Languages of India and the Linguistic Survey."

To Colonel Sir Arthur Henry McMahon, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, for his paper on "Seistan: Past and Present."

In the Colonial Section:—

To The Hon. Rodolphe Lemieux, K.C., M.P., for his paper on "Glimpses of French Canada."

To The Hon. J. G. Jenkins, Agent-General for South Australia, for his paper on "Social Conditions in Australia."

In the Applied Art Section:—

To Mr. Louis N. Parker, for his paper on "Historical Pageants."

To Mr. H. Yates Thompson, F.S.A., for his paper on "Some Illuminated Manuscripts of Continental Europe."

To Mr. Harry Powell, for his paper on "Cut Glass."

Of recent years it has been the practice that no medal should be awarded to readers of papers who had previously received medals from the Society. Acting on this rule the Council were precluded from considering the following papers:—In the Indian Section, the paper by Major Percy Molesworth Sykes, C.M.G., on "The Parsis of Persia." In the Colonial Section, the paper by Sir Neville Lubbock, K.C.M.G., on "Imperial Questions in the West Indies." In the Applied Art Section, the paper by Mr. Cyril Davenport, F.S.A., on "English Royal Heraldry."

The Council, however, desire to express their appreciation of these papers by thanking their authors for them.

X.—Owen Jones Prizes.

After the death, in 1874, of Owen Jones, a committee was formed to collect subscriptions for the purpose of founding a memorial. The money thus obtained was partly expended in erecting a monument over his grave in Kensal Green, and the balance (a sum of £400) was presented to the Council of the Society of Arts upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes have now been awarded annually since the year 1878 on the results of the annual competition of the Board of Education.

Six prizes were awarded this Session, each prize consisting, in accordance with the regulations laid down for the administration of the Trust, of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The list of the successful candidates has already appeared in the *Journal*.*

The next award will be made this summer, on the result of the present year's examinations. Six prizes have again been offered for competition.

XI.—North London Exhibition Trust.

In 1865 the Committee of the North London Working Classes and Industrial Exhibition (1864) presented to the Society of Arts a sum of £157, the balance of the surplus from that exhibition, with a view to the award annually of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art Workmanship Competitions were discontinued after 1870, and since that date the funds arising from the Trust have been disposed of as far as possible in a manner which might accord with the intention of the donors.† There was in 1902 a small accumulation of the interest on the invested capital, and the Council decided that a very proper way of disposing of the available amount would be to offer it in art workmanship prizes for students connected with that part of the metropolis where the North London Exhibition was held. They, therefore, offered prizes for Art Workmanship amounting to Fourteen Guineas (a First Prize of £7 7s., a Second of £4 4s., and a Third of £3 3s.), to students in the Art classes of the Northampton Institute, Clerkenwell.

The prizes were duly awarded in November, 1903, and as the result of the competition appeared satisfactory, the offer was renewed in 1904 and 1905, with the result that three prizes as before were awarded to successful students in the Artistic Crafts Department of the Institute.‡

Similar prizes have been offered for the current year, and no doubt the result of the competition will be reported to the Council in due course.

XII.—Prizes for Drawing.

Since 1889, the Council have annually placed at the disposal of the Royal Drawing Society, for competition among the candidates at its annual examination, 12 Bronze Medals, and these medals were awarded for drawings sent in by students to the exhibition held by the Drawing Society in April last.

XIII.—Examinations.

The number of candidates entering for the Society's examinations is now so large, and the additional work involved by the addition of the Advanced Stage so considerable, that it is not possible to include in the Annual Report the review of the examinations for the year, as has been the practice for many years past. A separate supplementary report on the examination of 1905 was published in the *Journal* of October 13th last after the results of the three stages had all been issued, and it is proposed to follow the same plan for this year.

The system adopted in 1905 was found to work perfectly well, and no alterations of any importance were therefore considered necessary for the present year. Swedish was added to the list of subjects in Stages II. and III., and the subject of Danish was altered into Danish and Norwegian.

After the issue of the results, a good many complaints were made that an undue proportion of medals and prizes were taken by teachers, or by persons professionally engaged in the subject of examination, and the Council, after giving very careful consideration to the matter, determined that in future no prize or medal in any subject should be awarded to anyone who had acted as a teacher in that subject, and that no prize or medal should be awarded to any person over the age of 23, whose profession or occupation was connected with the subject of examination, unless the candidate had been a regular attendant at an instruction class during the previous twelve months. The Council were reluctant to modify the regulations after the issue of the annual programme, but they consented to do so in consideration of the many urgent applications which were made to them on the subject.

The increase in the number of candidates this year was by no means as great as in 1905 on the addition of the Third Stage, and this perhaps could hardly have been expected. The total number of papers worked was 24,179, the number last year being 23,804. These were divided among the various Stages as follows:—Stage I., 8,536; Stage II., 10,738; Stage III., 4,905. The corresponding figures for 1905 were—Stage I., 8,427; Stage II., 10,533; Stage III., 4,844. It will be seen

* See *Journal*, vol. liii., p. 1057, Sept. 22, 1905.

† See Report of the Council for 1904-5, *Journal*, vol. liii., p. 856, June 30, 1905.

‡ The following are the names of the successful students:—1905: First Prize, L. E. Stanton; Second, A. Holm; Third, H. J. Rowley and W. Gilbert (æq.) The names for 1903 and 1904 were given in last year's Report.

therefore that there was a slight increase in each Stage.

The Council do not contemplate any modifications in the system next year, as it seems to work with perfect smoothness and to give general satisfaction to all concerned.

They have to express their indebtedness to those City companies who have liberally contributed to the Prize Fund. The Clothworkers' Company provide annually prizes to the amount of £30. The Goldsmiths' Company have this year given a donation of £50, and the Skinners' Company £5.

XIV.—Viva Voce Examinations in Modern Languages.

Up to the present date 11 examinations have been held this year in London and in Manchester. Arrangements have also been made for holding examinations at several other centres.

At these examinations 307 candidates presented themselves, of whom 225 passed (38 with distinction) and 82 failed. The languages taken up were French, German, Spanish, and Italian.

The results of previous years are as follows:—

Year.	Number Examined.	Passed.	Failed.
1902	280	202	78
1903	456	324	132
1904	540	375	165
1905	681	502	179

These examinations are held at any of the Society's centres where the necessary arrangements can be made. They are held at any date convenient to the local committee. The examination includes dictation, reading, and conversation, and the examination is so arranged as to test efficiency in a colloquial knowledge of the language, without laying too much stress on minute grammatical accuracy. Candidates who are reported upon as highly qualified by the examiners, receive a certificate of having passed with distinction.

The examiners are Mr. E. L. Naftel for French, Professor H. G. Atkins for German, Professor Ramirez for Spanish, and Mr. Luigi Ricci for Italian.

The numbers this year are not likely to show any considerable increase on 1905. This may probably be accounted for by the fact that since the institution of these Examinations in 1902, Oral Examinations have been added to the programme of the University Local Examinations. The Cambridge Syndicate first held such examinations in the winter of 1902, while the Oxford delegates established them last summer. At the same time it must be remembered that the two systems cover different ground, and really there is but little clashing between them.

XV.—Practical Examinations in Music, 1905.

The practical examinations in Music were not concluded last year until the 5th July, too late for the results to be included in the Report of the Council.

The examination was conducted by Dr. Ernest Walker, M.A., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 437 candidates entered, and of these 418 were examined, an increase of 139 as compared with the previous year. There were 319 passes and 99 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, viola, and clarinet. 343 entered for the piano, 257 of whom passed; 55 entered for the violin, of whom 47 passed; 3 entered for the violoncello, all of whom passed; 14 entered for singing, of whom 9 passed; 2 entered and passed for the viola, and one for the clarinet. No medals were awarded.

XVI.—Practical Examinations in Music, 1906.

The Practical Examinations for the present year have not yet been concluded. They commenced on Monday, June 18th. They will be finished on July 4th, after which a summary of the results will be given in the *Journal*. The work of the examination is being carried out by the same examiners as in the last five years. 477 candidates have entered for the present examinations, an increase on last year of 40.

XVII.—Leather for Bookbinding.

It was stated in last year's report that the revised edition of the Report of the Committee on Leather for Bookbinding, though nearly ready for publication, had not then been issued. It was published in November.

It will be remembered that in the year 1900 the Council of the Society, at the request of a provisional Committee of persons interested in the production of durable leather for bookbinding, appointed a Committee, of which Viscount Cobham was chairman, to inquire into, and report on, the durability of the leathers now used for binding books. In the following year this Committee presented a Report, which was published by the Society. The Committee succeeded in accumulating evidence to show that the general belief that the leather now used for bookbinding is inferior to that which was formerly employed is justified; and they also formulated definite instructions, by following which they believed that leather as good as any previously made may now be prepared. They satisfied themselves that it is quite possible to test leather in the laboratory in such a way that its permanence and general suitability for the purpose of bookbinding may be ascertained, and that there is therefore no reason why those who desire to have books bound in leather of a durable and sound character should not have their desires gratified. The Report also traced the causes which lead to the decay of leather used for bookbinding, and suggested the best means for avoiding such decay.

The Report attracted a great deal of attention, and practically the result was that a large number of librarians and others have required of their bookbinders that leather should be supplied which would fulfil the conditions laid down. It has had, therefore, the practical effect upon the trade which was desired. Under these circumstances it appeared to the Committee that it might be useful if an enlarged and revised edition of their Report could be issued, containing in fuller detail the instructions for the preparation and testing of leather, and giving also illustrations of the actual effect of light, heat, gas-fumes, and other injurious agencies upon leather.

The Council quite approved of the proposal, but they could not see their way to providing the necessary funds. Under these circumstances application was made to the Leathersellers' Company, who most liberally made a grant of £250, from which the cost of publication was defrayed. The actual cost was more than this, but the balance has been provided by the result of the sales.

A good deal of the original report has been re-written, its arrangement has been re-cast, and some additional matter has been added. A principal new feature of the book consists of the coloured illustrations. The frontispiece gives some examples of bindings in morocco and calf executed in the last fifty years, and showing the strongest evidence of decay. There are ten other coloured illustrations, showing the result of exposing samples of leather to various destructive agencies. These have been reproduced by photography, and may be taken to be as near facsimiles as it is possible to obtain of the original examples. The specifications for binding books which formed a part of the original Report are now fully illustrated with woodcuts, and there are some further illustrations showing the strength of leather treated in various manners, &c.

Twelve samples of leather prepared in accordance with the conclusions of the Committee's Report are given in the cover. These were kindly supplied by several firms whose liberality is duly acknowledged in the Report.

The Report is published by Messrs. George Bell and Sons, at the net price of 10s. 6d. Members of the Society requiring a copy can obtain one, at a discount of 25 per cent., by applying direct to the Secretary of the Society.

As an outcome of the publication of the Report, the suggestion has been made that a similar investigation might produce similar good results in various other industries where scientific knowledge is too often applied in the interest of cheapness rather than of excellence.

XVIII.—London Institution.

In the last Report of the Council a full account was given of the negotiations which had been carried on between the Board of Managers of the London Institution and the Council of the Society with regard to the proposal for the amalgamation of the two bodies. It was stated that the proposal having met with a good deal of opposition at the meeting of the Proprietors of the London Institution called to consider it in the spring of 1905, the Council had decided to abandon the scheme as far as they were concerned, and to discharge the Committee which they had appointed for its consideration.

At the General Meeting of Proprietors of the London Institution no decision was arrived at, but a Committee was appointed to confer

with the Board of Managers. In February last a communication was received from the Secretary of the London Institution stating that as the result of a Conference between the Board of Managers and the Committee of Proprietors, it had been resolved that the Society should be asked if it "would be prepared to re-open negotiations for the amalgamation of the Society with the Institution on the understanding that the new building for the Amalgamated Societies (if formed) should be situated either on the present site of the London Institution or elsewhere within the City of London."

By instructions of the Council the Secretary replied that the Council were perfectly ready to re-open the lapsed negotiations, provided it was understood that the question of the locality of the combined Institution was to be one of the matters for discussion. Some further correspondence on the subject took place, but it appeared that the London Institution Committee did not feel themselves empowered to carry on the discussion on any other basis, and as the Council were convinced that, with the experience of the London Institution before them, they were right in believing that a site in the City would be most unsuitable for an Institution of the character proposed, nothing came of the proposition.

The Council have nothing now to add to the statement included in their last year's Report, the views of which they have every reason to believe have been generally endorsed by the members.

XIX.—Franklin Commemoration.

A Special Meeting of the American Philosophical Society was held at Philadelphia on the 17th, 18th, 19th, and 20th of April last in commemoration of the 200th anniversary of the birth of Benjamin Franklin. The Society of Arts was requested to send a representative to the meeting, and at the request of the Council the British Ambassador at Washington, the Right Hon. Sir Henry Mortimer Durand, G.C.M.G., K.C.S.I., K.C.I.E., a Member of the Society of long standing, kindly undertook to act in this capacity.

The connection of Franklin with the Society was somewhat intimate. In 1755, the second year of the Society's existence, Franklin was elected a corresponding member, and in the List of Members published in 1756 he is described as "Benjamin Franklin, Esq., Philadelphia, F.R.S.." In the following year, 1757, he was in London as the representative of the Colonies, and attended at least one of the Society's meetings. A few years later, in 1761, he was appointed Chairman of the Committee of British Colonies and Trade.*

XX.—Conversazione.

The Society's annual Conversazione will be held on Tuesday next, the 3rd July, at the gardens of the Royal Botanic Society. This is the sixth year in succession for which the gardens have been placed at the disposition of the Society of Arts. In previous years the entertainment has been very successful, and the Council trust that the Conversazione next Tuesday may be attended by a large number of the members and their friends. The arrangements will be of the usual character.

XXI.—New Council.

In accordance with the provision of the Bylaws the four senior Vice-Presidents, not being Vice-Presidents nominated by the President, have to retire. Those coming under the rule this year are Sir William Abney, Sir James Dewar, Sir Walter Prideaux, and Sir John Wolfe-Barry. The Vice-Presidents nominated by the President are H.R.H. the Duke of Connaught, the Duke of Abercorn, and the Lord Chief Justice. Of the Ordinary Members of Council two retire by seniority and two by least attendance. The retiring members this year are Sir Mancherjee Bhownaggree, Colonel H. C. L. Holden, Sir Thomas Holdich, and Sir Westby Perceval.

It is the duty of the Council to supply these places by nominating four Vice-Presidents, of whom three must not have served on the Council during the past year, and four Ordinary Members of Council, all of whom must fulfil the same condition.

As Vice-Presidents the Council propose Sir Westby B. Perceval, who has served on the Council since 1902, and has acted as Chairman of the Committee of the Colonial Section, also the three following new Vice-Presidents :—The Duke of Westminster, the Hon. Charles W. Fremantle, and Sir Benjamin Baker. The two latter have acted on the Council in previous years, though not last year.

As Ordinary Members of Council the following are suggested :—Sir David Barr, who retired in 1905 after long and important service in the Political Department of the Indian Government, and in the same year became

* In the *Journal* for the 27th April, vol. lv., p. 633, will be found some notes on the connection of Franklin with the Society.

a member of the Council of India; Sir John Cameron Lamb, who retired in 1905 from one of the Secretaryships of the Post Office after nearly ten years' service in that capacity; Sir William Treacher, formerly Governor of British North Borneo, and Resident-General of the Federated Malay States; and Sir Aston Webb, the distinguished architect. None of these gentlemen have ever served on the Council before.

XXII.—Obituary.

The Council have to record with regret the death of various well-known members of the Society. By the death of Lord Fortescue the Society lost one of its oldest members (as Viscount Ebrington he joined the Society in 1854), and one who for many years took a very active part in its work. In the year of his election he became a member of the Council and its Chairman, in which capacity he delivered the Opening Address of the 101st session in 1854. Until ill-health compelled him to give up most of his public work he continued to take an active share in the proceedings of the Society. He never served on the Council after his retirement in 1857, though his interest in, and attachment to, the Society never flagged. As late as 1886 he was present at one of the meetings and took part in the discussion.

Lord Masham was a member of the Society of long standing, and in 1886 he received the Albert Medal in recognition of his services to the textile industries, especially the introduction of mechanical wool-combing and the utilisation of waste silk.

The Earl of Romney was the great-great-grandson of the second Lord Romney who was the second President of the Society (1761-1794). Lord Lingen was a member of the Society of Arts of 53 years' standing. In 1889 he took the chair at a meeting of the Society when Sir Douglas Galton read a paper on "The Sanitary Functions of County Councils."

Sir Wyndham Portal was also a very old member of the Society, he having been elected as far back as 1850. He was a Vice-President in 1890-92, and in that capacity became a member of the Royal Commission for the Chicago Exhibition, 1893. Mr. J. M. Maclean became a member of the Society in 1881, and served on the Council from 1883 to 1886. He was a member of the Committee of the Indian Section, and read four papers before the Society, for two of which he received the silver medal. Mr. F. C. Danvers was also a member of the Indian Section Committee. He had read two papers before the Society, for each of which he received a medal. Mr. Alfred Waterhouse, the eminent architect, was a member of the Society, though he never took any active part in its proceedings. Dr. Richard Garnett, the eminent bibliographer, was a member of the Society's Committees on the Deterioration of Paper and on Leather for Bookbinding, and on several occasions he took the chair at the evening meetings. Mr. G. A. Thrupp gave a course of Cantor Lectures on Coachbuilding in 1876, and was a frequent contributor to the *Journal* on subjects connected with carriage-building and with technical education.

Mr. W. T. Shaw, who joined the Society in 1874, was the originator of the proposal that the London Institution and the Society should be united into a single Institution. It was a source of regret to him, when, after the idea had been approved by the governing bodies of both corporations, the opposition raised by a section of the members of the Institution wrecked so promising a scheme.

Mr. Charles Critchett was Assistant Secretary of the Society from 1856 to 1869, and Educational Officer from that year until 1879, when he was elected by the Council a life member. Mr. J. J. Vezey was a very frequent attendant at the Society's evening meetings from his election in 1890 down to a short time before his death. Mr. H. W. Chubb read a paper on "Locks and Safes" before the Society in 1893. Sir Clinton Dawkins was elected a member in 1900, but he took no active share in the Society's work. Mr. H. E. Newton, the well-known patent agent, was elected a member in 1885. His father and uncle, his predecessors in the firm, had also been members of the Society. Mr. Edgar Horne, the Chairman of the Prudential Assurance Company, became a life member of the Society in 1878. Mr. F. J. Horniman, the founder of the Horniman Museum at Forest Hill, which was presented by him to the London County Council five years ago, was a life member of the Society of Arts since 1872.

Sir Charles Tennant, the head of the important business known as the United Alkali Company, was elected a member in 1880. Miss Manning, who was so well known as the Honorary Secretary of the National Indian Association, was a member of the Society of Arts since 1875. The distinguished American astronomer and physicist, Professor S. P. Langley, who for long held the position

of Secretary of the Smithsonian Institution at Washington, was elected an Honorary Corresponding Member of the Society in 1896.

Obituary notices of all the above, and of some of the other members of the Society, who have died during the past year, will be found in the columns of the *Journal*.

XXIII.—Honorary Royal Members.

Under the provision of the By-laws, which authorise the Council every year to elect a certain number of life members of the Society, the Council elected Their Majesties the Kings of Portugal and of Greece as Honorary Royal Members of the Society on the occasions of Their Majesties' visits to this country last year. His Royal Highness the President was good enough to communicate Their elections to Their Majesties in each case.

XXIV.—List of Members.

The number of life and subscribing members on the Society's books is 3,723, practically the same as last year; this includes a few Institutions in Union who subscribe from their own funds. The number of new members elected during the year was 373; the losses by death and resignation amounted to 372.

XXV.—Finance.

The annual statement of receipts and expenditure was published—in accordance with the usual practice—in the *Journal* last week. It shows the revenue and expenditure for the financial year ending May 31st last, the Assets and Liabilities of the Society, its Investments and the Trusts standing in its name.

An amount of nearly £3,000 (£2,992 11s.) invested in Consols and War Loan was sold out and re-invested in Newcastle $3\frac{1}{2}$ per cent. stock. The expenses of the examinations were heavier than usual on account of the changes in the system. Of recent years the examinations have been self-supporting, but now they involve a small loss to the Society. This, however, is not a matter for serious consideration, in view of the great usefulness of the examinations and their educational value. The cost of the *Journal*, always a heavy item, has this year been increased by the efforts which have been made to render it more valuable and interesting by including a larger amount of miscellaneous matter in its pages and its consequent increase in size.

The Chairman, in moving the adoption of the Report, said he thought it was a record of good work done in the interests of the Society, and of the public, which they represented. The Report showed that the Society was still in full vigour, and fulfilled a great many of the needs of modern requirements, and he thought they deserved well at the hands of the public. He did not think there was any need for him to say anything further, as he was of opinion that the Report of the Society's work during the past year spoke for itself.

Mr. William Whittaker, F.R.S., seconded the adoption of the Report. He considered it was an interesting document, as it correctly epitomised the work the Society had accomplished during the year, and the progress it had made. There was one thing he was sorry for, and that was the inability of the Council to come to a satisfactory arrangement with the Board of Managers of the London Institution; but he felt sure the Council of the Society were quite right in not agreeing to go so far East for a site for the proposed joint building.

Mr. Martin Wood said the Report showed that the Society had done good work during the year. He asked for the number of members the Society had lost by death and withdrawal during the past twelve months, and also the number of new members who had been elected during the same period. He had hoped that the Report would have stated what steps the Council were taking to acquire new premises, and spoke of the necessity of forming the nucleus of a reserve fund for this purpose. He considered that a Society which possessed so many eminent, influential, and prosperous members as the Society of Arts should have a reserve fund sufficient to enable it to erect a building of its own, and expressed the hope that during the coming year some advance might be made in this matter.

The Secretary replied to Mr. Martin Wood's remarks by stating that the number of new members elected during the year was, as mentioned in the body of the Report, 373, and that the losses by death and resignation were 372. He also said that during the past 25 years the Society had accumulated a reserve fund of £21,205. He thought if any blame was due to their predecessors that certainly the present members had no reason to reproach themselves.

The Chairman referred to the fact that he had held office as Treasurer of the Society, and had been connected with the Council in other capacities for over 20 years, during which time he had watched the reserve fund grow until it had reached its present proportions. He said he should like to find the Society mentioned in the wills of some of the members, and hoped that, as the result of Mr. Martin Wood's suggestion, the members would take the matter to heart.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., M.D., said, with regard to the accumulated funds of the Society, that a large proportion of the credit for their present satisfactory condition was due not only to the Council, but to their Secretary, Sir Henry Trueman Wood. It would take a great deal more than £21,000 to build a suitable house; but he thought, if the thing was once started, and there was any necessity to make an appeal to the public, that the Society stood in such good credit both in this country and India, as well as in the Colonies, that their reserve fund would very soon be doubled. He also wished to refer to the able manner in which Sir Henry Wood, the Secretary, was aided in the general administration of the Society's work by Mr. Henry B. Wheatley, the Assistant Secretary, Mr. Samuel Digby, the Secretary of the Indian and Colonial Sections, and the other officers of the Society.

The adoption of the Report was then agreed to.

The CHAIRMAN, in complimentary terms, moved a cordial vote of thanks to Sir Henry Trueman Wood (the Secretary), Mr. Henry B. Wheatley (the Assistant Secretary), Mr. Samuel Digby (the Secretary of the Indian and Colonial Sections), Mr. George Davenport (the Chief Clerk), Mr. J. H. Buchanan (the Accountant), and the other officers of the Society.

The SECRETARY returned thanks for this expression of confidence in himself and in the other officers of the Society. He remarked that this was the 26th year that he had returned thanks for a similar vote.

The ballot having remained open for one hour, and the Scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.

PRESIDENT.

H.R.H. The Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. The Duke of Connaught and Strathearn, K.G.
Duke of Abercorn, K.G., C.B.
The Lord Chief Justice, G C.M.G.
Sir Benjamin Baker, K.C.B., K.C.M.G., F.R.S.
Sir James Blyth, Bart.
Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.
Sir William Crookes, D.Sc., F.R.S.
Lord Curzon of Kedleston, G.C.S.I., G.C.I.E.
Lewis Foreman Day.
Francis Elgar, LL.D., F.R.S.
Hon. Sir Charles W. Fremantle, K.C.B.
Robert Kaye Gray.
Sir Charles Augustus Hartley, K.C.M.G.
Lord Kelvin, O.M., G.C.V.O., D.C.L., LL.D., F.R.S.
Sir William Lee-Warner, K.C.S.I.
Sir Philip Magnus, M.P.
The Earl of Onslow, G.C.M.G.
Sir Westby B. Perceval, K.C.M.G.
Sir William Henry Preece, K.C.B., F.R.S.
Sir Owen Roberts, M.A., D.C.L., F.S.A.
Sir Marcus Samuel, Bart.
Alexander Siemens.
Duke of Westminster.

ORDINARY MEMBERS OF COUNCIL.

Colonel Sir David William Keith Barr, K.C.S.I.
Sir Steuart Colvin Bayley, K.C.S.I., C.I.E.
Sir William Bousfield, M.A., LL.D.
Michael Carteighe, F.O.S.
William Charles Knight Clowes, M.A.
Henry Graham Harris.
Sir John Cameron Lamb, C.B., C.M.G.
Hon. Richard Clere Parsons, M.A.
Sir Boverton Redwood, D.Sc., F.R.S.E., F.C.S.
Prof. John Millar Thomson, LL.D., F.R.S.
Sir William Hood Treacher, K.C.M.G.
Sir Aston Webb, R.A.

TREASURERS.

Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.
Carmichael Thomas.

SECRETARY.

Sir Henry Trueman Wood, M.A.

On the motion of the CHAIRMAN, a vote of thanks to the Scrutineers was carried unanimously.

Sir BOVERTON REDWOOD, D.Sc., F.R.S.E., proposed a cordial vote of thanks to the Chairman for his services in presiding at the meeting, and also as Chairman of Council during the past year. As a young member of Council, he felt a little hesitation in doing so, but Sir Owen Roberts, he said, had proved an ideal Chairman, and, under his guidance, the work of the Society during the past twelve months had been admirably done.

The motion was seconded by Mr. MICHAEL CARTEIGHE, and carried unanimously.

The CHAIRMAN acknowledged the vote of thanks.

The meeting then adjourned.

THE INDUSTRIES AND TRADE OF PORTUGAL.

Portugal, with the exception of Ireland, the most westerly kingdom of Europe, forms part of the Spanish Peninsula, and has an area of 34,254 square miles, with a population of 6,000,000. Its mountains with few exceptions are prolongations of those of Spain. The principal rivers—the Tagus, Douro, and Guadiana—enter from Spain, and with the other numerous streams are filled with fish. There are practically 40,000 persons engaged in fishing, the annual catch being very valuable. Nearly £400,000 worth of sardines was exported in 1904. The valleys are fertile and produce considerable quantities of maize, rye, wheat, vegetables, and fruit. Of the whole area 45·8 per cent. is uncultivated, although, according to the American Vice-Consul at Lisbon, millions of acres are susceptible of reclamation for cultivation. With the exception of shipbuilding, cotton-spinning and weaving, the manufacturing industry of the country is rather insignificant. Sheep and goats are bred in the mountainous region. Wine is the most important product, the exports in 1904 amounting in value to £1,936,000. The mineral wealth consists of coal, wolfram, iron, marble, and alabaster, manganese, zinc, copper, and limestone. Iron is principally found near Bragança in the province of Traz-os-Montes, and the construction of a railway is now being proceeded with, from Mirandella to Bragança, which will connect the iron mining district with the Douro railway, and thus facilitate the export of iron ore from Oporto. The principal copper mines are those at San Domingos, near the Guadianá, and at Aljustrel in the province of Alemtejo. The most important wolfram mine is at Panasqueira near Covilba. Tin is found at Rabordosa, Codeço, Villa Real and Vizeu; manganese at Mertola, Grandola and Odemira; antimony at Gondomar, Vallongo, Paredes, Monte Mor and Alcontim; anthracite coal at São Pedro da Cova and Bussaco; and lignite at Buarcos, Caleço de Veado, Arrimalde and Chão Preto. Mineral waters are found at Vizella, Taipas, Gerez, Felgueira, Vidago, São Pedro do Sul, Luso, Vimierio, Cucos, &c. Viticulture is, of course, the most important of the agricultural industries of the country, and there are many descriptions of wine produced. There are first the red and white wines of the province of Minho, which are exported to Brazil, and consumed in Portugal itself, chiefly in the north. These wines are very much appreciated in the United States and South America. Then there are the table wines produced in the provinces of Douro, Tras-os-Montes, and Beira Alta. Finally, the well-known port wine, the trade in which is suffering from depression, the total exports during the year 1904 having been 4,782,000 gallons, against 5,676,000 gallons in 1903. As regards the foreign trade of Portugal, the total imports in 1904 amounted to £16,180,000, of which £12,400,000 were for home consumption. The exports were valued at £9,910,000, of which £6,140,000 were home products and the remainder foreign and colonial re-exports. The principal exports are cork, fish (principally sardines), animals, fruit, and vegetables, olive oil, copper ore, and wine. During the ten months, ended October, 1905, the imports for home consumption into Portugal were valued at £11,670,000, and the exports of domestic produce and manufacture at £5,415,000. There appears to be a growing demand for automobiles, typewriting machines, boots and shoes, gloves, and other manufactured articles. The future of Portugal, from an industrial and commercial standpoint, depends altogether upon her people. The country is rich in minerals, but many of its mines are unworked, and millions of acres of land are untilled, not for lack of capital, but through the nation not seeing the needs created by modern enterprise and activity.

THE PORT OF HAMBURG.

Some interesting particulars relating to the Port of Hamburg are given by Consul-General Sir William Ward, in his report on the trade of the district (No. 3627) just issued. The works which have been carried on by the State of Hamburg during the past five years for deepening the channel of the River Elbe below Hamburg, and on which about £755,000 have been expended, have recently been completed, the result being that there is at present a depth at ordinary high water in the river as far as the port of 32·80 feet. It is now the intention to deepen the various dock basins so as to give the entire harbour of Hamburg a depth proportionate to that above-mentioned. The total water area of the Hamburg Harbour, including the two large docks completed in 1904, is 1,260 acres. Of this area, 550 acres can be utilised for the accommodation of sea-going vessels, 22 acres can be used by river craft, 175 acres consist in canals, and the remainder is open river. Notwithstanding the constantly increasing amount annually spent by the Government of Hamburg for the purpose of improving and extending the arrangements and accommodation of the port, the net receipts derived from vessels visiting it now represent an important item in the general revenue of the State. The net receipts for the present year from the use of the quays by sea-going ships and river craft is estimated at £243,050 as against £240,650 in 1905. About 29 per cent. of the whole sum received for the use of the quays is contributed by vessels belonging to the Hamburg American Steamship Company. This company pays annually the sum of £650,000 for the lease of the new docks completed in 1904, and a further sum of £5,500 for the lease of a portion of the harbour at Cuxhaven. Several other large Hamburg shipping companies pay together £170,000 annually for leases of quay space, and smaller amounts are paid by other companies. The authorities confidently expect a further development of the shipping trade of Hamburg during the current year.

HOME INDUSTRIES.

The Protection of Shipping.—The Departmental Committee appointed by the Government to investigate the question of national indemnity, or insurance of shipping against loss from capture by the enemy at sea in time of war, is a strong one, and there will be great satisfaction at the early adoption of the recommendation of the Royal Commission on Supply of Food and Raw Material in time of war, that a Committee should be appointed to work out the whole matter. No question is of more vital importance to the country than that of how to protect our food and raw material supplies in time of war. Never before within the range of history has a nation been so dependent upon over-sea supplies for its existence. It may be taken as beyond dispute, that if things are left as they are, and the country becomes involved in war with a great maritime Power, possibly a combination of Powers, freights and insurance would rise very seriously, and much distress would be caused to the poor. But it might well be worse than this, there might be panic that would bring about a terrible state of things during the early weeks, or months, of the war, when the British control of the sea was incomplete. The enormous damage done to British commerce by France in the Revolutionary War, and at a time when the French navy had been utterly disorganised by the Revolution, and the excesses which accompanied it, are too often forgotten, nor is it remembered that it took this country a dozen years to establish complete control of the sea. In our second war with the United States, too, at a time when the British navy was relatively stronger to that of other nations than it has ever been before or since, immense damage was done to British shipping. Taking the entire maritime power of the United States—both navy and privateers—into consideration, 1,554 British vessels of one sort and another were captured. And it must be remembered that British trade is now so great that it would be impossible to provide adequate convoys for all trading ships, and though steam has marked out certain routes upon the ocean to be followed by merchant ships, and so limited the extent of ocean to be patrolled, the first duty of the navy upon the outbreak of war will be to hunt down and destroy the enemy's fleets, which means that for a time it will have little time to give to the merchantmen.

The British Carrying Trade.—The immensity of the carrying trade to be protected, and the liabilities to be accepted if the Government are to indemnify or insure, are shown in figures submitted to the Royal Commission which it may be useful to recall. On the basis of the total foreign trade of the United Kingdom (import and export) in 1903, of which it may be assumed that about two-thirds was carried in British bottoms, the value of cargo per ton of British shipping entering and clearing with cargo may be taken at about £10 5s., so that, on a basis of a tonnage of 8,900,000 tons, the total value of cargo liable to capture would be in round figures £91,000,000. Taking the figures together:—

Value of shipping	£89,000,000
Value of cargoes	91,000,000
Total	£180,000,000

the cost of indemnity to the Government would vary according to the percentage of losses in some such proportion as the following:—If 1 per cent. of our shipping were lost, £1,800,000; 2½ per cent. £4,500,000; 5 per cent., £9,000,000; 10 per cent., £18,000,000. The real crux of the situation, as the Commission pointed out, lies in the framing of such regulations as would, on the one hand, protect the Government against extravagant losses, and, on the other, avoid rendering the indemnity to a large degree nugatory. The suggestion that the Government should indemnify shipowners and cargo owners for all losses incurred, is objected to on the ground firstly, that it would throw the whole cost of the losses incurred at sea during war upon the taxpayers; next, that it would hold out an inducement to shipowners and cargo owners alike to over-value their ships and cargoes; and, thirdly, that it would hold out an inducement to both to take undue risks. On the other hand, an indemnity would go far to prevent panic, since both shipowners and cargo owners would carry on the maritime trade of the country as usual, seeing that at the worst they would be guaranteed against loss.

National Indemnity or Insurance.—Whilst it will be for the Committee to consider the question of national indemnity, they will also examine alternative schemes of national insurance; the proposal that the Government should take the place of the underwriters and insure shipowners and shippers against war risk at premiums which, as there would be no question of making a profit, could be made very moderate in amount. It is argued in favour of insurance, (1) that the State should charge reasonable premiums and so partially recoup its outlays, thus preventing the whole cost of the losses from falling upon the taxpayers; (2) that both shipowners and cargo owners would value more highly services for which they paid than services rendered to them gratuitously; (3) that insurance would remove the temptation either to over-value or to incur undue risks. Whether it will be possible to fix the value of the vessel to be indemnified is questioned by some experts. In ordinary business the value to be insured is often a matter of bargain and discussion, and it was suggested to the Royal Commission that though theoretically the Government might be able to deal with this matter in the same way as is now done by underwriters, in practice they would find it a source of embarrassment. The Royal Commission seemed to lean to indemnity holding that even if some preference would accrue to the shipowner the importance of maintaining efficient means of transport in time of war, and of keeping rates of freight so

far as possible at a normal level is so great as to outweigh this objection, and that a scheme of national indemnity would leave it more open to the Government, acting through the Admiralty or otherwise, to impose conditions, to prescribe rules, and to keep greater control of the risks that, in some form or another, will undoubtedly have to be run. The whole question is one of great complexity. The country must look mainly for security to the strength of its navy, and only in a less degree upon the widespread resources of the mercantile fleet, and its power to carry on trade and reach all possible sources of supply whenever they exist; but, even if navy and marine do all that is expected of them, the experience of the United States in their war with Spain shows that it takes little to create panic, and it is against panic in the early stages of a great maritime war that the Imperial Government seeks to guard. It would seem that to do so effectively there must be national indemnity, or insurance of shipowners and cargo owners of some sort.

Railway Company Expenditure.—It may be anticipated that not only will home railways not require to spend much capital upon building new tracks and branches for some years to come, but that their outlay upon additional locomotives will in the same period be very small. In the thirty years from 1870 to 1900, the annual expenditure of the railway companies upon new locomotives averaged £700,000 per annum, and for the four years ended 1904, rather less than £600,000 per annum. But during these thirty-four years the companies accumulated a number of surplus engines which the *Statist* estimates roughly—for complete data are wanting—at 2,000 locomotives. This large and excessive stock of locomotives should enable them to handle the whole of the additional traffic they are likely to secure for a decade without having to charge capital account for any additions to locomotive stock. The companies will thus derive the advantage to their net profit from having to find practically no capital for new locomotives for some years to come, whereas in the past they have been accustomed to provide about £7,000,000 of capital in each decade for additions to their locomotive stock. During the last four years the railways have handled their traffic more skilfully. They have constructed a number of more powerful freight engines, and these freight engines have hauled a much larger amount of traffic per train. Also, the old and relatively light engines have been loaded more fully up to their capacity. In both ways a large reduction in freight-train mileage has been effected. The economy of capital in the matter of new locomotives is only a small portion of the advantage to be derived from making both passenger and freight engines more effective. Speaking of railways, the Board of Trade has appointed a very strong committee with Mr. Alfred Clayton Cole, a director of the Bank of England, as Chairman, to consider and report what changes, if any, are desirable in the form and scope of the accounts and statistical returns (capital, traffic receipts, and expenditure) rendered by railway companies under the Railway Regulation Acts. The existing form of accounts were drawn up nearly forty years ago. Since then, and more especially in the last ten years, many developments have occurred which have rendered very necessary the compilation of additional data.

The Market for Wines.—It is understood that the Government of Cape Colony is making a vigorous attempt to push the sale of Cape wines in the United Kingdom. The decrease in the consumption of wine in Great Britain during recent years has been very marked. Whilst population has steadily increased, the sale of wine has diminished absolutely, and to a large degree. In 1901 the total import of wine was 16,546,206 gallons; in 1905 it had fallen to 12,731,050 gallons. And there was decrease in almost every kind of wine. Wines imported in cask fell from 14,487,625 gallons to 10,875,229 gallons, and of wines imported in bottles, sparkling champagne fell from 1,235,490 gallons to 1,193,920 gallons; Saumur from 145,559 gallons to 122,997 gallons; Burgundy from 12,895 gallons to 12,541 gallons; Moselle from 49,068 gallons to 47,114 gallons. Hock was the only wine that showed any increase in consumption, and that very slight, from 49,958 gallons to 50,211 gallons. In 1873 the population stood at 32,000,000 and wine consumption at 18,027,000 gallons; in 1905, as stated above, the consumption was considerably under 13,000,000 gallons, whilst the population has increased roughly to 43,000,000. Taking continental countries, it will be found that in the five years, 1900-05, the imports of wine from France fell from 5,517,828 gallons to 3,860,858 gallons; from Spain from 4,184,554 gallons to 3 066,170 gallons; from Portugal from 3,908,065 gallons to 2,952,876 gallons. On the other hand, the imports from the British possessions, taking the same five years, rose from 774,680 gallons to 1,061,469 gallons. The imports from British South Africa rose from 4,683 to 15,136 gallons; from South Australia from 404,144 gallons to 426,057 gallons; and from Victoria from 322,615 gallons to 431,196 gallons. It will be seen that the imports from the Colonies are still comparatively very small, and it is much to be hoped that the efforts now being made by the Cape Government may lead to a large increase in imports. The Cape and Australian wines have at present no market outside their own save that of the United Kingdom, and it has been uphill work to create a market here. The wines are excellent, the prices very low; all that is wanted is better knowledge on the part of the British consumer of the merits of colonial wines.

The Cotton Industry.—The cotton industry continues in a very thriving condition and there is every likelihood of its remaining so for some time to come. The shipment of cotton piece goods goes on growing.

For the five months ended May 31 it was 2,670,363,600 yards as against 2,185,582,700 yards in 1904, and the increased demand is pretty well distributed. Bengal has increased her takings by 46,933,000 yards, Turkey by 38,624,000, Argentine Republic by 28,289,000, the United States by 12,251,000, Germany by 9,731,000, Japan by 9,550,000. On the other hand there have been decreased shipments to China to the extent of 39,165,000 yards, to Egypt of 10,108,000, to Brazil of 79,963,000, and to Madras of 7,671,000 Many firms are engaged for several months ahead, and the market remains healthy. Expert authority leans to the belief that, given good weather, 12,000,000 bales may be expected from the United States next year, and the increase in the product of the British Empire, thanks to the efforts of the British Cotton Association, may be expected to be considerable. Anyway, Lancashire spinners are fully covered for some months to come. The growing exports of textile machinery may be noted. The value for the five months ended May 31 last was £2,730,717 as against £1,961,035 for the corresponding period of 1904, and £2,082,275 for 1905. Russia alone shows decrease in her orders which may be accounted for by the condition of the country. The increase for British India is £174,251, for the United States £103,398, for Japan £48,866, and for Germany £48,154.

OBITUARY.

William Thomas Shaw.—On the 17th inst., Mr. W. T. Shaw died at his residence at Newbury. He was born at Newbury in 1837, and educated at the grammar school of that town. Early in life he entered the office of Mr. Thomas De la Rue and Co., and he soon obtained a prominent position in that business, which he held until his retirement a few years ago. He was a good mechanician, and some of his earliest inventions were connected with Optics. He wrote the article on "Vision" for "Chambers's Cyclopædia," and on Jan. 10th, 1861, he read a paper before the Royal Society, entitled "Description of a new Optical Instrument called the Stereotrope," which was communicated by Dr. Warren De la Rue. He was much interested in Cycles, and invented a gearing of great ingenuity. He joined in most of the discussions before the Society of Arts, when papers were read on this subject. He also made improvements in fountain pens, and his name occurs several times in connection with forms described by Mr. J. P. Maginnis, in his Cantor Lectures on "Reservoir, Fountain, and Stylographic Pens." He was elected a member of the Society of Arts in 1872. It was on his initiative that the suggestion was made for an amalgamation of the London Institution (of which he was one of the Managers) with the Society. He was a member of the Joint Committee appointed to consider the proposal, a Committee which reported in favour of the scheme. He was elected a Vice-President of the Society at the annual meeting on June 28th, 1905, but he declined the office, preferring not to serve at the same time on the governing bodies of two institutions between which negotiations were pending. Mr. Shaw, after his retirement from business, took an active part in the affairs of St. Bartholomew's Hospital.

GENERAL NOTES.

Tobacco in Tuscany.—Tuscany is well suited to the cultivation of tobacco, which would be very profitable were the cultivation not hindered by most stringent regulations. The pioneer of this new and promising culture, says Major Chapman, in his report on the trade of Florence (No. 648, Miscellaneous Series) wae Baron Bellino Ricasoli, in the Chiane Senesi, who obtained very satisfactory results. On the transfer of the estates to the Counts Bastogi, the latter took advantage of the experience acquired by the farmers to develop the cultivation, and solicited from the Government permission to grow as many as 1,000,000 plants. In the province of Arezzo there is a considerable area of tobacco under cultivation; also in several other communes. It is estimated that one hectare of land (2·47 acres) can carry 15,000 plants; for the "spadone" these plants would yield on an average 150,000 leaves, of a weight of 3,300 lbs. (avoir.); for the seed-leaf, 180,000, of a weight of 3,960 lbs. (avoir.). The gross profit for the "spadone" is £2 17s. 7d. per quintal (220·46 lbs.), of the seed-leaf, £2 16s. per quintal.

MEETINGS FOR THE ENSUING WEEK.

Monday, July 2...Faraday Society (at the House of the Society of Arts), John-street, Adelphi, W.C., 8 p.m. 1. Prof. Kr. Birkeland, "The Oxidation of Atmospheric Nitrogen in Electric Arcs." 2. Dr. Eugene Haanel, "Preliminary Report on the Experiments made at Sault Ste. Marie on the Smelting of Canadian Iron Ores by the Electro-Thermic Process." 3. Dr. George Senter, "Electrolysis of Dilute Solutions of Acids and Alkalis at Low Potentials: Dissolving of Platinum at the Anode by a Direct Current."

Tuesday, July 3...SOCIETY OF ARTS, 9 p.m. Conversazione at the Gardens of the Royal Botanic Society, Regent's-park, N.W.

Wednesday, July 4. Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. W. H. St. John Hope, "The Cistercian Abbey of Beaulieu, in the County of Southampton."

Thursday, July 5...Chemical, Burlington House, W., 8½ p.m. 1. Mr. G. Barger, "Saponarin, a new Glucoside, coloured blue with Iodine." 2 Mr. F. Tutin, "The Constitution of Umbellulone." 3. Mr. H. D. Law, "Electrolytic Oxidation." 4. Mr. A. W. Bain, "The Action of Ethyl Iodide and of Propyl Iodide on the Disodium Derivative of Diacetylacetone."

Friday, July 6. Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.

Journal of the Society of Arts.

No. 2,798. VOL. LIV.

FRIDAY, JULY 6, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CONVERSAZIONE.

The Society's Annual Conversazione was held in the gardens of the Royal Botanic Society, Inner Circle, Regent's-park, on Tuesday evening, 3rd inst.

The reception was held by Sir Owen Roberts, D.C.L., Chairman, and the following Members of the late and present Councils:—Sir William Abney, K.C.B., F.R.S.; Sir Mancherjee Bhownaggree, K.C.I.E.; Sir William Bousfield, LL.D.; Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.; Mr. Lewis Foreman Day; Francis Elgar, LL.D., F.R.S.; Sir Charles Augustus Hartley, K.C.M.G.; Sir John Cameron Lamb, C.B., C.M.G.; Hon. Richard Clere Parsons; Sir Boverton Redwood, D.Sc.; Sir Marcus Samuel, Bart.; Mr. Carmichael Thomas; Sir William Hood Treacher, K.C.M.G.; Sir Aston Webb, R.A.

A Selection of Music was performed by the String Band of H.M. Royal Artillery (Conductor: Cavaliere L. Zaverthal, M.V.O.) in the Conservatory, and by the Band of H.M. Scots Guards (Conductor: Mr. F. W. Wood) in the Gardens.

An Exhibition of Growing and Cut Roses and other Flowers was arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

The Tropical House, containing the giant water lily (Victoria Regia), and other interesting tropical plants, was open to visitors.

Two performances of Selections from Pastoral Plays were given in the Gardens by Mr Patrick Kirwan's Idyllic Players.

A Concert and Entertainment by members of Mr. Kirwan's Company of Idyllic Players, with Choruses by Children (Bellew and Stock's Choir) were given in the Club House.

The number of visitors attending the Conversazione was 2,382.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

MODERN WARSHIPS.

By Sir William White, K.C.B., F.R.S.

Lecture II.—Delivered February 5th, 1906.

The use of armour-plating for the protection of warships was a consequence of the introduction of shell-guns capable of horizontal fire. This form of attack was devised about 85 years ago. A French officer, General Paixhans, who was intimately connected with the introduction of shell-guns, at once recognised their destructive effect on the wood-built ships then universally employed, and proposed to coat their sides with iron plates. The French Government appointed a Commission to examine the proposal; it was pronounced impracticable for sea-going ships, and for thirty years the idea of protection against shell-fire lay dormant. In the interval numerous and powerful shell-guns were added to the armaments of warships and their powers of offence were increased greatly in consequence, but the ships themselves were built much in the same fashion as in Nelson's time when horizontal firing shell-guns were unknown and when solid spherical shot were the only projectiles. It was recognised that the introduction of the shell-gun had destroyed the balance which had long existed between powers of offence and defence and had intensified the risk of inflammability of the wood-hulls. Loss of life and destruction of *morale* were admittedly important elements of victory or defeat, and the use of concussion shells increased those risks immensely. Yet this unsatisfactory condition was accepted for more than thirty years until the destruction of the Turkish fleet at Sinope (1854) by shell fire from Russian battleships furnished a demonstration of the power of shell-guns and the necessity for protection, and compelled action.

Mr. Stevens, of New York, in 1840 had enforced the necessity for iron-clad vessels, and secured a contract for the construction of an armoured battery for the United States Navy about 1843. The vessel was altered repeatedly and actually remained incomplete on the stocks twenty years after European fleets of armoured vessels were at sea, so that she exercised little, if any, effect on naval policy although she was the first ironclad begun.

The credit of initiating the construction of the earliest completed ironclads belongs to the Emperor Napoleon III. These ironclads were floating batteries built in 1854 and used during the Crimean war. They were short, broad, slow vessels of shallow draught, capable of making passages across the sea, but not truly sea-going, and were specially designed for the attack of land fortifications. The whole broadside down to a few feet below water was covered with iron plates about four inches thick. Three of these vessels took part in the attack on Kinburn and their armour proved sufficiently strong to keep out shot as well as shell. This immunity from serious damage was more remarkable when contrasted with the injuries sustained by unarmoured ships which took part in the bombardment of Sebastopol and other Russian fortresses. Several similar floating batteries were built in this country immediately after, but British naval authorities at that time generally agreed that armour protection if fitted to battleships would seriously diminish the sea-going qualities. The balance of naval opinion was, therefore, strongly against any attempt being made to carry great loads of side-armour on battleships, and this opinion had to be faced by Napoleon III. when he took a different view and decided to construct seagoing ironclads to take the place of unarmoured two- and three-deckers. An eminent French naval architect, M. Dupuy de Lome—who had already distinguished himself by the design of steam line-of-battle ships—undertook the responsibility for the new designs. Before the end of 1857 his plans were matured, and in the following year three wood-built ironclad frigates were put on the stocks in French dockyards. These vessels were similar in under-water form and dimensions to the unarmoured two-deckers which had preceded them ; but instead of having two fighting decks and two tiers of guns they were frigate-built with a single tier of guns and were consequently of much less height above water. Weight thus saved, as compared with the two-deckers, was utilised in providing a cuirass o iron plates about 4½ inches thick, completely protecting the broadside from end to end and extending to a few feet below water. This cuirass was pierced on the main deck with gunports for the principal armament, which consisted of the heaviest guns then available.

While the French were making rapid progress with these ironclads, nothing was done in this country beyond discussing the subject at great length and with much heat. British designs for sea-going ironclads were available, but naval opinion was distinctly against the type, and experience with the floating batteries was held to show that vessels burdened with heavy loads of armour and armament could not be well-behaved at sea. Public anxiety naturally increased as more French vessels were laid down and rapidly pressed forward, and, finally (in May, 1859), the first English ironclad, the *Warrior*, was ordered, to be followed soon after by the *Black Prince*, a sister ship, and by two smaller vessels. After a short interval it was decided to "convert" into ironclads several two-deckers then building and so to match the *Gloire* and her consorts. From that time onward the construction of armoured ships has been uninterrupted and the struggle between armour and guns has been incessant. Warships have grown in dimensions, speed, armour-protection, armament and cost, and the limit has not yet been reached.

Throughout this period of armour-clad construction advocates have been found for the contrary policy of building larger numbers of small, swift, well-armed unarmoured vessels, rather than a much smaller number of armoured vessels of great individual power. The fundamental idea of those who have maintained this view is that even the largest and best defended vessels necessarily remain exposed to very serious risk of foundering, or damage in action as will cripple their efficiency, and that by numbers alone, with a consequent wide distribution of offensive power in many ships, can such risks be met. When locomotive torpedoes were introduced the dangers of under-water attack were magnified, the argument against large armoured vessels became more weighty, and in France especlally the so-called *jeune école* pressed it unceasingly and with much ability. It is a notable fact, however, that the great majority of naval officers, experienced in the management of fleets, have never favoured this policy; they have maintained that even when the best possible use has been made of a numerous flotilla in which the units are of small individual size and power, they would be

destroyed in detail by a compact and powerful fleet of armoured battleships capable of manœuvring together and remaining under a single effective command. Further, it has never been admitted by seamen that small ships can possess such steadiness of gun platform or power of maintaining speed in rough seas as are possessed by vessels of large dimensions. As an able French writer, now dead, said in the course of the controversy: "Experience proves that the sea is always kindest to the largest ships."

At various times advocates have appeared of the abandonment of vertical side-armour and the substitution of deck-armour for the protection of the vitals of battleships. In cruisers of the "protected type" this system has been widely followed. In some Navies it has been applied also to battleships. The *Italia* and *Lepanto* of the Italian Navy, for instance, although of very large size and high speed, have no vertical side-armour, but only strong steel under-water decks. It is interesting to recall that, about twenty years ago, the First Lord of the Admiralty, in his place in Parliament, referred to the possibility of two powerful battleships which were then being built as possibly the last vessels in which vertical armour would play so prominent a part. This forecast was based on the belief that the gun had proved, and would continue to be, the victor over armour; and that, in the endeavour to increase defence in association with other requisite qualities, permissible limits of size and cost would be exceeded in battleships. Subsequent events have shown how dangerous it is to prophecy in regard to the future of warship-construction, or the upper limits likely to be accepted for size and cost.

When the use of armour began, there was universal agreement amongst naval constructors that the best material available was soft (or malleable) iron. Armour plates 4½ inches thick were manufactured with difficulty at that date, and were of small dimensions and weight. At first these plates were forged under steam hammers: British manufacturers soon substituted the process of "rolling" for forging; and the advantages of this method of manufacture were so considerable that it became general. Inventors were naturally busy at such a period of transition, and made innumerable and varied proposals for alternative methods of protection. The Admiralty appointed a special Committee to deal with the subject, and a great number of experiments were made, which, in the end, resulted in the recommendation that soft iron plates secured to teak-wood backing furnished the best practical form of defence against the then existing forms of attack. Chilled cast-iron projectiles were then the best available, and guns were of moderate power. The records of the Iron-Plate Committee are even now instructive, as well as amusing; they furnish examples of inventions which are being perpetually re-invented by amateur designers. Here one finds numerous suggestions for "elastic support" to armour by means of springs, special cellular devices, or compressible materials; which shall yield on the impact of projectiles, absorb energy, and lessen destructive effect. The supposed advantages of "oblique armour" formed the basis of another set of proposals, and led to the suggestion of very singular external forms for warships. Endless schemes of a more or less visionary character were put forward by educated men, whose acquaintance with the subjects dealt with was that of "rank outsiders." The Committee dealt with all these matters patiently and courteously, thus relieving the executive departments of the Admiralty from what would otherwise have been exceedingly troublesome work. After years of useful service, the Committee was dissolved, its mission being accomplished, and its experimental investigations having determined the best quality of armour which could be employed, the most suitable structural arrangements to be formed on ships' sides behind the armour, and the most efficient means of attaching armour plates thereto. Incidentally these experiments did much to improve both naval artillery and projectiles.

In the earliest French sea-going ironclads, as explained above, the whole broadsides were protected by armour-plates extending to a few feet under water. In the first British ironclad, the *Warrior*, it was decided to leave the ends unarmoured, and to concentrate armour protection on a battery 213 feet long, the ends of the battery being enclosed by transverse armoured bulkheads. The length of the ship was 380 feet, and at the period of construction exceeded that of any other warship, as well as that of any merchant ship except the *Great Eastern*. Within the armoured battery, it was intended, in the original design, to carry twenty-six 68-pounder smooth-bore guns on the main deck, and ten similar guns were to be mounted outside the battery. On the upper deck two guns of the same calibre were to be carried as bow and stern chasers, that arrangement being customary in frigates.

The displacement of the *Warrior* was about 9,000 tons; her cost £380,000; her maximum speed 14 knots. When compared with the two or three-decked line-of-battle ships completed about the same time, the step in advance was remarkable. The three-decker *Victoria*, for instance, launched in November, 1859, was 260 feet long, of 7,000 tons displacement, with a speed of 12½ knots. Her armament consisted of 121 smooth-bore guns mounted on three gun-decks and an upper-deck. Most of these guns were of small power. There were 58 32-pounders, 62 58-pounder 8-inch shell guns (weighing 65 cwt. each), and one 8-inch 68-pounder pivot-gun (weighing 95 cwt.). Her cost was £217,000. The *Warrior*, as originally designed, was to carry 38 68-pounders, the most powerful guns then in our naval service. Her armament was, therefore, extremely formidable, while her armour protection made her battery invulnerable, not merely to 8-inch shell-guns but to spherical cast-iron projectiles fired by the 68-pounders at close range. The 4½-inch armour-plates on the sides of the *Warrior* were backed by 18 inches of teak. The adoption of iron for the hull gave her a distinct superiority over the French ironclads then building as regards strength, durability, and defensive power. From the technical side the design was meritorious and original: the vessel was of fine appearance, and all the promises made by the designers were fulfilled. The *Warrior* was a most successful ship, rendered excellent service in the Royal Navy for a long period, but was never required to serve in war.

In the contest between armour and guns, the first round was clearly in favour of armour. All the earliest ironclads were proof against the attack of the strongest guns at close range. There were signs, however, from the first that this relative disadvantage would not be accepted permanently by gun-makers. Rifled Armstrong breechloaders, throwing 110-lb. projectiles and capable of piercing five inches of wrought iron at a range of 1,000 yards, were actually in process of manufacture when the *Warrior* was begun; and her original armament of 68-pounders was changed before completion. Owing to circumstances which need not be detailed, the original Armstrong system of breech-loading was rejected by the Royal Navy, and muzzle-loading rifled guns were adopted. The next great series of ironclads (*Minotaur* class) commenced in 1861 were originally intended to carry fifty 110-pounder Armstrong guns, but were actually armed with a less number of heavier muzzle-loading guns. The *Bellerophon* (designed in 1863) carried 9-inch 12-ton guns as her principal armament; these guns were capable of piercing about ten inches of wrought iron at 1,000 yards. Ten-inch 18-ton guns quickly followed, capable of piercing 11¾ inches of iron at the same range. Eleven-inch 25-ton guns capable of piercing 13 inches of wrought iron were available in 1866, and were surpassed in turn by twelve-inch guns of 35 and 38 tons weight, which could perforate 17¾ inches of wrought iron. Finally in the *Inflexible* (designed in 1873) muzzle-loading guns reached their maximum dimensions, the calibre being 16 inches, weight 80 tons, and length nearly 27 feet. The projectiles each weighed 1,700 lbs. and were capable of penetrating 23 inches of wrought iron at 1,000 yards.

This rapid and continuous increase in the size and power of naval guns compelled corresponding increase in defence. As the power of armaments grew, so thicknesses of armour were increased. As heavier guns were mounted, the number of guns was diminished. Whereas the *Warrior* was designed to carry 38 guns and the *Minotaur* 50 guns, the *Inflexible* of much greater displacement only carried four 80-ton guns. Instead of so-called "complete protection" possessed by vessels of the *Minotaur* class and necessary for mounting the numerous broadside guns, it was decided in the *Bellerophon* and in some French ships of earlier date to restrict the length of the armoured battery, and to provide in that battery only the spaces required for working the guns. Consequently the protective material on warships became subdivided into two groups:—first, side-armour which extended to the height of the main-deck from a few feet below water, and formed a "water-line belt" protecting buoyancy and stability; second, armour on the sides and ends of batteries protecting armament. The area of armoured-broadside above water became smaller, and for a given weight of armour the thickness could be increased. Even when thus limited considerable weights were devoted to armour protection. In the *Warrior*, with unarmoured ends, 11 per cent. of the total weight was devoted to armour: in the *Minotaur* with complete protection more than 17 per cent. of the total weight was assigned to armour: and in the *Bellerophon* with central battery about 15 per cent. Above the water-line belt, and outside the central battery in ships of that type, large unprotected areas

existed. These unprotected spaces were assigned to living-quarters for the crews, and no men were stationed therein in action. The fundamental idea of this arrangement was that, as the water-line belt rose to a considerable height above water and extended from stem to stern, no serious risk resulted from surrendering to destruction spaces outside the batteries. These spaces might be riddled or shattered by shot and shell, and yet the ships would remain afloat and capable of continuing an engagement.

The broadside system of mounting guns, first adopted for ironclads, had been used for centuries. At an early period in the ironclad reconstruction Cowper-Coles in this country and Ericsson in the United States perceived the great advantages to be obtained by mounting heavy guns on revolving turn tables and protecting them by armoured turrets. The famous American *Monitor*, designed by Ericsson early in the Civil War, had its armament mounted on this system. In England, Captain Cowper-Coles was permitted to "convert" a line-of-battle-ship (the *Royal Sovereign*) into a coast-defence turret-ship of moderate freeboard. About 1866-7 two sea-going turret-ships (*Monarch* and *Captain*) were built for the Royal Navy, the first designed by Sir Edward Reed, and the *Captain*, designed by Cowper-Coles, with the assistance of Messrs. Laird. The *Captain* had a moderate freeboard; her upper-deck was intended to be about eight feet above water, but in the completed ship was little more than six feet. She had two armoured turrets, each containing a pair of 25-ton guns, and the upper-deck of the ship formed the *glacis* over which these guns fired. The broadside was armoured throughout the length to the height of the upper-deck. In the *Monarch* the armour was disposed on the "belt-and-battery" system; the freeboard was about 14 feet and the pair of turrets (each containing two 25-ton guns) had their bases protected by the central battery armour. The guns were, therefore, at a greater height above water than those of the *Captain*. The low freeboard in the *Captain* in association with her great sail power, caused that vessel to capsize in the Bay of Biscay in September, 1870.

Before that accident happened another radical change had been decided upon by the Admiralty. The *Devastation* and *Thunderer* (designed by Sir Edward Reed in 1868-9) were the first examples of sea-going battle-ships having no sail-power. These vessels were fitted with twin screws and had a large coal supply. They were armed with four 35-ton guns, throwing projectiles weighing 714 lbs. The displacement was rather greater than that of the *Warrior*, but whereas the *Warrior* carried less than 1,000 tons of 4½-inch armour, the *Devastation* carried 2,500 tons, the maximum thickness being 12 inches; 28 per cent. of her displacement was devoted to protection, as against 11 per cent. in the *Warrior*. The vertical side-armour rose to an upper-deck about three feet above water, much as in the American *Monitor* type, and was 12 inches thick. The upper-deck was protected by thick iron plating which formed a "roof" to the "vitals." On its central portion an armoured enclosure (or "breastwork") of less width than the ship was built, and at each end of the breastwork was placed a turret containing two 35-ton guns. All four guns were available on both broadsides, and had very large arcs of horizontal command. Without any movement of the vessel, by simply training the turrets, the fire of all four guns could be concentrated on the larger portion of the horizon, but only two guns could be fired right ahead or right astern.

The use of twin screws and duplicate engines in asssociation with large coal supply was considered sufficient provision against the danger of "breakdown" at sea. Up to the time of the design of these ships, and, indeed, for some years after, a very large body of naval opinion was opposed to the abandonment of sail-power, and a considerable number of ironclads, armed on the broadside system, and equipped with good sail-power, were built after the *Devastation* class. Seamen naturally hesitated in entirely abandoning propulsion by sails in favour of propulsion by steam, but the change initiated in the *Devastation* type was the precursor of a general movement in favour of the exclusive use of steam-power for propulsion. One strong and, indeed, unanswerable argument against the continued use of sails was found in the serious danger in action from the presence of heavy masts and spars aloft. It was admitted that spars and rigging must be cleared away when preparing for action; but, when all precautions had been taken, masts and rigging involved undesirable risks of fouling propellers and making ships unmanageable. So sails eventually disappeared from warships; and in the mercantile marine, since the adoption of twin screws and the great economies

effected in coal consumption, sail-power has practically ceased to be employed. The construction of sailing ships has fallen steadily year by year in this country, and it continues only in countries where artificial bounties have favoured it.

The loss of the *Captain* took place when the *Devastation* and *Thunderer* were in an early stage of completion, and a special "Committee on Designs for Ships of War" was appointed by Mr. Childers to make a thorough investigation of the conditions of stability of other warships built and building. Lord Dufferin was chairman; the Committee was numerous and representative; it was probably the strongest body ever assembled to discuss warship designs. One result of their investigations was the addition of unarmoured superstructures to the *Devastation* and *Thunderer* in order to increase the stability; but in the main the design was approved. The Committee recommended that in future battle-ships there should be a concentration of the armour in a "central-citadel" of great thickness, instead of a breastwork; and the design of the *Inflexible* (prepared by Sir Nathaniel Barnaby in 1873), gave expression to this view. The length of the citadel was about one-third the total length of the ship; the turrets were placed *en echelon* within the citadel. The limitation of armoured area made it possible to increase the thickness of the armour greatly. On the sides the aggregate thickness was 24 inches, the greatest thickness of armour ever carried. The total weight of armour was 27 per cent. of the displacement; nearly the same proportion as in the breastwork *Monitor* class. The armour was fitted in two layers each 12 inches thick with wood backing between the two thicknesses as well as behind the inner thickness. The heights of freeboard and of the turret guns above water were about the same as in the *Devastation* class. The two turrets were placed near the sides at opposite corners of the citadel, instead of being at the middle-line as in previous turret ships. When the ship was motionless it was possible to bring all four 80-ton guns to bear directly ahead, directly astern and on each broadside; but superstructures fitted above the upper deck prevented the guns from being trained across the keel-line while continuing to bear on an enemy. About one-third of the length at each end of the ship had no vertical armour; it was protected only by a strong steel deck fitted a few feet under water before and abaft the citadel. The spaces above this under-water deck were minutely subdivided into water-tight compartments and packed to a considerable extent with cork or occupied by coal and stores. The Committee were of opinion that these unarmoured ends would be slowly destructible in action; that when riddled they would remain capable of contributing to buoyancy and stability; and that the impregnable central citadel would keep the ship afloat and enable her to continue a fight. On the other side it was urged that small quick-firing guns would be capable of freely penetrating the unarmoured ends and of producing sufficient damage to admit large quantities of water which would speedily "water-log" the compartments above the protective deck, put the vessel out of trim, make her unmanageable, and place her at the mercy of her enemies. It was asserted that although the citadel and turrets remained impregnable or little damaged, yet the vessel might be sunk by numerous light guns. These diverse views were urged with great force and ultimately were referred to a Committee appointed to consider the matter. Admiral Sir James Hope was the chairman; the late Mr. William Froude undertook charge of the model experiments and carried them out with great skill. After full investigation the Committee reported in favour of the design, but admitted that it was impossible to determine the possible effects of artillery fire on unarmoured ends without full scale experiments involving considerable time and outlay. The difficulty of arranging and carrying out such experiments was great and they were never made. At the battle of the Yalu (1894) there were, however, two ironclad ships of the central citadel type on the Chinese side, while the Japanese ships carried powerful armaments of modern quick-firing guns. An interesting object-lesson was thus presented. When the action ended the Chinese ironclads —which according to opponents of the central citadel type should have been sunk or captured —remained afloat little injured and still capable of service. They actually followed up the Japanese squadron when it left the battle-field at the close of the day. One of these vessels formed part of a subsidiary squadron attached to the Japanese fleet in the battle of the Korean Straits, but on that occasion took no prominent part. So far, therefore, as experience in war can be quoted, the view taken by Lord Dufferin's Committee, and embodied in the central citadel type, was proved correct; the subsequent abandonment of that type was due to other considerations.

The *Inflexible* was in process of building during seven or eight years, and illustrated the evil of commencing construction of warships before the gun armaments are finally determined. She was intended originally to carry guns of about 63 tons which only existed on paper. The guns actually carried each weighed 80 tons, and were the most formidable muzzle-loaders afloat. Their design and construction was a slow process, and the ship was delayed greatly in building, besides being altered repeatedly. At the bombardment of Alexandria (1882) she did good service under the command of Captain (now Admiral of the Fleet) Sir John Fisher.

Armour as well as armament was in a state of transition when the *Inflexible* was built. The use of soft wrought iron was challenged by Messrs. Schneider (the French armour plate makers) who introduced a superior quality of steel armour, which proved excellent in its resistance to penetration, but was liable to crack seriously under the attack of comparatively light guns. English armour-plate makers, therefore, attempted and succeeded eventually in producing "steel-faced iron" armour, which combined resistance to perforation with much less liability to crack. In the *Inflexible* herself the turret armour was of the new "compound" quality, and its weight and thickness were reduced while the intended protection was maintained. Locomotive torpedoes were also coming into use at that time. The *Inflexible* was the first battleship in which they were installed during construction. Mr. Whitehead's invention was then in its infancy; but it was felt absolutely necessary to provide for its installation in a ship which, at the period of her construction, was the largest, most powerful, and most costly vessel of war that had been laid down for any navy. All these changes and improvements involved delay and additional cost, besides involving great anxiety to the responsible designer, Sir Nathaniel Barnaby; yet, in the end, success was attained, and the intentions of the design were realised.

ENGINEERING EXPORT TRADE.

By W. Pollard Digby.

It has been said that the English are a nation of shopkeepers; it would be more accurate to use the term "traders." In either case it appears that the individual is obliged, owing to an arrangement of very long standing, either to produce something by his labour, to convey a product by the same means, or by providing capital to persuade some one less far-sighted to perform these offices for him. The industries of a country of course depend upon its climatic geological formation and situation relative to the world's markets. The most considerable industrial asset we have, without which the cotton trade would be almost impossible, is the coal and iron in our possession. As these become easily accessible with the advance of mechanical knowledge, the population in the neighbourhood of these deposits turned their attention to a larger extent to the textile industries. Although we cannot to-day boast with Addison that "the inhabitants of the frozen zone are clothed with the fleeces of our sheep," we can, at least, pride ourselves with having supplied in the first instance, and still continuing to supply, certain markets with all the appliances of an engineering nature with which they can carry out certain manufacturing processes for themselves.

Of our present export trade, particularly in engineering articles, much is due to the prior demands of our home industries. Our locomotive export trade is the direct heritage of the internal development which followed the opening of the Liverpool and Manchester Railway. Abroad there arose a desire for railways, and an important export trade arose. Into the economies of external trade it is not necessary to enter here, and speculation may be dismissed as to how far there were or are exports of capital and the manner in which payment was obtained. Pre-eminent in cotton spinning we have equipped the mills of the United States, India and Japan with machinery, whereby the raw cotton can be worked up nearer to the place of its production. Successful as shipowners of British-made vessels, we became successful as shipbuilders for other countries, it being always remembered that local raw material in the first place rendered it possible to manufacture for our own needs.

Our trade in machinery, our ship-building, and, incidentally, our spinning and weaving industries have been largely aided in their advance by the comparative nearness of our manufacturing centres to the sea. Especially favoured in this respect Great Britain has, until recently, been troubled by no misgivings as to her position as the leading manufacturer of machinery and engineering commodities generally in the world. Her output includes iron and steel in forms, cast, rolled or forged, locomotives, steam-engines, pumps, textile and agricultural machinery, electrical goods, and ships of all kinds. In regard to all of these a reputation of first-class work is still the boast of British manufacturers, but a very large proportion of the trade in agricultural, and a large proportion of the demand for electrical machinery in the neutral markets of the world is now met by American and German material. Nothwithstanding this competition, regarded externally, British engineering exports are equal in total value to those of Germany and the United States combined, while taken per head of population they are much greater. For instance,

the value of the total engineering export trade of England, Germany, and the United States for the years 1900 (a good year) and 1902 (a moderate year) are :—

	£.
England, 1900	62,702,000
,, 1902	56,830,000
Germany, 1900	28,759,000
,, 1902	30,267,000
United States, 1900	24,383,000
,, 1902	19,711,000

Considering the figures for a series of years, it appears that Great Britain suffered a severe decline after the year 1900. There has since been a steady recovery, the total for iron and steel manufacture, making telegraph cables and ships alone, in 1905 being no less than £62,436,000. The United States had her best recent year during the same period, and has since suffered a gradual decline, only lately experiencing any upward tendency. Germany has suffered a falling off since 1902 of the same gradual nature as the improvement in British trade.

More important even than wars and rumours of wars are the purely economic effects of fluctuations in supply and demand which have their basis in the food and cotton crops of agricultural countries, and which really dominate the output of the metallurgical industries.

In spite of the decline following the high values reached in 1900, we find the total value of British engineering exports a handsome figure, and are led to the conclusion that the downward tendency was only of a temporary character, the apparently large proportion of trade regarded as lost being merely one of the inevitable fluctuations in commercial history. Continued high standards of construction and finish will undoubtedly tell in the end; the experienced buyer, unless in the cheap-jack business, invariably returning to that firm which supplies him with an article which will not fall to pieces as soon as left.

While it is quite unnecessary to recite columns upon columns of figures, mention may be made of some of the total values of specific engineering exports of British manufacture during last year. These embraced steam engines for agricultural purposes, £1,098,698; locomotives, £2,312,403 (of which £824,805 were sent to South American countries); other steam engines, £2,312,043; agricultural machinery, £1,047,272; sewing machines, £1,967,505; mining machinery, £832,624; textile machinery, £5,607,436; other machinery, £7,368,112. Ships amounted in value to £5,429,292. Iron and steel in their numerous forms, cast, rolled, or wrought, in the form of bars, plates, rails, angles, tees, channels, pipes, wheels, flanges, bolts, axles, chains, anchors, and so forth, amounted to £31,827,142.

Among the many features to which attention should be directed in regard to export trade, the packing of machinery and instruments for export is of supreme importance and merits careful attention. The trader, whose engineering commodities have, by their superior design and staying qualities, won for him a considerable foreign trade, must become a student of the climatic conditions of the countries to which his manufactures are transported, of the conditions of transport, and facilities for handling his goods, both at the port of landing and up country. It would naturally be extremely prejudicial to electrical machinery, say, if sent in too heavy a package to a port on the African coast, it became subject to all the disabilities of heavy packages removed from cranes and railways, *i.e.*, much levering over, any side up, with as much care and consideration as the ordinary labourer displays towards a package which he considers has been especially sent to strain his sinews, and therefore deserving of some hallmark of his resentment; in some cases even local repacking in smaller boxes becomes necessary for transportation up country, under awkward conditions as to obtaining suitable boxes, packing, and protecting material. If it is found that facilities for handling exists right up to the works (it is not pleasant in England to have machinery delayed owing to the non-existence of a suitable trolley in the neighbourhood) well and good. Another class of mishap has been at this end of the transit, *i.e.*, the breaking through of the wheels of the vehicle carrying heavy machinery into an insufficiently protected sewer, and it is therefore imperative that the weights of packages should coincide with the buyer's requests. Probably a strong heavy package will be best, but in cases where the machinery must be taken over rough roads and light bridges, necessarily it must be split up into a variety of packages even at the risk of their not all arriving simultaneously. It will be found conducive to satisfaction on the part of the buyer if such things are studied as enclosing spares of the less expensive small parts, such as bolts and nuts, keys, cottars, and other fittings, the losing or breaking of which is not particularly likely, but would, in the case of an oil-engine up country very possibly mean a cessation of running till such time as a new one can be contrived. The co-operation of the buyer who has become intimately acquainted with the effects of climatic and other drawbacks is, of course, very desirable. The exporter must endeavour to see the matter from the buyer's point of view, and the buyer to indicate to him in what way local circumstances differ from the normal.

In the wet season of a tropical climate rust especially is to be guarded against. Plating or platinising of small delicate parts of instruments, judicious greasing, the use of sealed water-tight cases are recognised means of combating this form of deterioration. Ebonite and rubber are also very susceptible to moisture. These may be protected by grease; insulations on dynamo coils, &c., are best protected by shellac varnish. The time of year at which the purchase will be despatched is worth noting; a shrewd observer has observed that cases despatched from this country in the winter are liable to be filled with damp straw.

In the case of a country which has from eight to ten months of non-summer conditions per annum, this is a serious consideration.

It should not be very difficult to design a special class of machinery suited to the conditions met with in climates presenting extremes of heat and moisture, and this consideration brings us to a very important feature in the export of machinery, *i.e.*, the necessity for standardising, not only each type and set, but every separate part, so that a cabled code-word will be all that is necessary to insure the dispatch of exactly the right size of field coil, or piston rod, or whatever happens to have succumbed. The gradual elimination of awkward projections, or castings calculated to set up strains in cooling, and thus liable to break under slight concussion, has now been going on for some time in the leading ironworks of this country, and it should be possible for them each to arrive at their own especial set of sections, not in a spirit of desire merely to differ from competing firms, but in honest endeavour to improve on their design. In the more delicate electrical instruments necessary in high-tension station work, the packing question is especially important. The price of these is necessarily high, owing to the extreme care necessary to insure accuracy, and the consequent employment of highly-skilled workmen. That the result of so much careful regulation should be exposed to all the vibration, if nothing worse, of a long journey with no further protection than a perfunctory padding up of the moving parts is not sound business. As at present designed it would seem that the only way to deal with these is to remove the more delicate parts separately. Even in this country much expense is incurred by the insecure packing of such articles. In the case of measuring and testing instruments, many of them of special design, it is not easy to see how a special pattern, less susceptible to shocks, temperature, &c., could be produced for exportation, but with heavy machinery a little study of the conditions should enable the manufacturer to produce an article especially suited to the conditions under which it will have to work. Every consideration points to complete and comprehensive standardisation as the most practical method of overcoming the disabilities of producing in one country articles especially suitable for use in a totally different one. This has been recognised for some considerable time by a number of leading manufacturers, and the work of the Engineering Standards Committee, to which Government departments and the leading engineering institutions have delegated members, cannot be too highly praised. The contractor is often heard to lament the eccentricities of the consulting engineer in requiring a complication or combination peculiar to himself in each individual case, instead of adopting the particular design which he (the contractor) has adopted as representing perfection in that article. This is a legitimate cause of complaint, as the constant demand for a fresh type, or alteration of an existing type, causes delay in manufacture and an expense of production which it seems difficult to justify. The publication of a list of approved standards by a body of investigators thoroughly qualified to pronounce on these matters should be welcomed by consulting engineer, manufacturer, and buyer alike.

There is no reason why standardisation should destroy that competition which is one of the recognised incentives to high-class production. The result of its universal adoption would be to cheapen production to an enormous extent, and consequently leave the manufacturer more chance of excelling by the quality and finish of his work, rather than by a claimed higher output or longer life difficult to justify in the face of constant changes in the machinery of production, and in the continued evolution of improved types. The advantage to the buyer has been pretty generally acknowledged unofficially by his tendency to adhere to certain makes for certain purposes, as produced by well-known houses, *e.g.*, boilers, steam engines, pumps, tramway motors, trucks, and controllers. The manufacturer is quick to appreciate the advantages of standardised co-operation and limiting of types, as witness the Cement Manufacturers' Association and the Cable Makers' Association among others. It remains for the consulting engineer to appreciate the safeguard afforded by specifying a product which has been tested in a variety of ways, supposing, of course, the absolute uniformity of one article with the rest.

Besides these two important factors, another very powerful cause exists from the fact that the excellence of our manufactures is not more widely known and appreciated. There is something lacking in the performances of the Intelligence Department. Government has endeavoured to improve matters by causing the issue of Consular Reports; but the endeavours of an official, probably fully engaged otherwise, and unprovided with sufficient technical assistance, to keep issuing circulars giving correct and up-to-date reports of the condition of trade as it affects diverse industries over a very wide area, can hardly be expected to be satisfactory, and are, as a matter of fact, pretty widely recognised as inefficient. The matter in them is apt to be insufficiently detailed, and so classified as to render it difficult to distinguish the truly significant items, and is very liable to the fatal disadvantages (from a commercial point of view) of being some months late. But while it may be said of the Government department that it has at least made an effort; the supineness of the British trader himself is difficult to understand in this respect. He sees before him the shining example of the German commercial man, who, on the slightest excuse, will penetrate the sanctums of Westminster fully prepared to maintain the advantages of the specialties of his principals. The establishment of some means whereby he may be promptly informed of the condition of trade in likely centres, and whereby the local buyers may be at the same time informed of the advantages of dealing with

him, is certainly not beyond his powers. We can therefore only ascribe his retiring habits in this respect to the truly British mental altitude which assumes that the rest of the world feels the same admiration for his institutions as he does himself.

However, the manufacturer has some cause for complaint when the daily press, not content with lengthy, and frequently non-technical, lectures on the way things should be done, begins to draw the inference from such evidence as comes to hand that the British trader is an effete and worn-out imitation of the lively and intelligent inhabitant, let us say, of the United States.

The great mass of the nation do not take into consideration that the English newspaper is read all over the globe, and where only two or three different newspapers penetrate, the words of the one which speaks with the most emphasis and conviction, carry with them considerable weight. We are still liable to this complaint, which induces certain people, and through them certain newspapers, to cultivate the theory that, because their interest in the country or its trade is small, that country and its trade and everything else belonging to it are to be objects of derision and perpetual targets for the shafts of sarcasm, or the mud of abuse. This is not business, neither is it philanthropy, nor statesmanship, nor even truth. We have had far too much in the non-technical press of jeremiads concerning our lost supremacy, and unfounded decrying of what our manufacturers can and do habitually perform. In the name of fair play, this gratuitous advertisement of our rivals, and unfair belittling of our fellow countrymen, should cease.

STATE PURCHASE OF RAILWAYS.

In view of the possible purchase of the Irish railways by the Imperial Government, it may be interesting to give some particulars, which are taken from Mr. C. des Graz's report (No. 3606, Annual Series) of the recent dealings of the Italian Government with the railways of Italy. On July 1st, 1905, the State took over the management of those lines of railways which were its own property, but which had been leased since July 1st, 1885, to the Mediterranean, Adriatic, and Sicilian Railway Companies. In settling accounts with these three companies the State incurred a liability of about £20,000,000, of which £16,000,000 represented the value of the material provided by the companies during the twenty years of their administration of the railways —1885-1905. A great part of this debt has already been settled by the State. Part has been withheld as a guarantee, or as representing certain contested items. The manner in which the payment has been effected is as follows:—Firstly, by means of special inscribed certficates of the value of £20,000 each. These certificates bear interest at the rate of 3·65 per cent., free of all taxes, present or future, and are to be redeemed within forty years from July 1st, 1906. Of these certificates the State was empowered to issue £4,000,000 to the former railway companies, £3,400,000 to the savings banks of Lombardy, £3,000,000 to the Bank of Italy, £800,000 and £200,000 respectively to the Banks of Naples and of Sicily, and finally £3,600,000 to the Bank of Deposits and Loans. Secondly, by payments in cash, viz., £1,000,000 to be taken from the surplus of the State Consolidated revenue assigned to the Bank of Deposits and Loans for the service of the redeemable debt. The remainder was paid out of the cash available in the Treasury chest, by ordinary financial Treasury operations, and by the issue of inscribed certificates of the nature indicated above to savings banks, Monts de Piété, insurance companies, and credit institutions. There are also certain lines forming part of the Adriatic and Mediterranean railways which were not the property of the State. Under the terms of the original concession, and in virtue of the modifications subsequently introduced, these lines, of an extent of 1,440 miles, reverted on July 1, 1905, to the possession and administration of the Southern Railways Company. Some of the concessions dated as far back as 1862: all were to lapse in 1966. The Government has now come to an agreement with the Società per le Strade Ferrate Meridionali to take over these lines and to incorporate them with the other lines representing some 6,690 miles in extent, which are already under the direct management of the State. No fresh burden is imposed on the Treasury by the transaction. The agreement provides that an annual sum of about £1,600,000 shall be paid by the State to the company until December 31st, 1966, a sum inferior in amount to the annual subsidy in respect of such lines which the Government had hitherto been paying to the company, and would have to continue to pay until the expiry of the concessions. No special provision will be necessary in connection with the payment of this sum which is already inserted in the yearly budget of the Treasury.

Twelve million pounds, to be spread over the three financial years, 1905-7, has been voted in connection with the initial working of the railways by the State for necessary improvements, and for the purchase of additional rolling stock. This money will be borrowed from the Bank of Deposits and Loans, or will be supplied out of available Treasury funds, or by other financial operations of the Treasury. The interest charged, and sinking fund for the extinction of this capital, within forty years, will be provided out of the ordinary revenue from State railways. It is the intention of the present Government to lay before Parliament a complete financial scheme providing for the large expenditure requisite on the State railways during the next ten years. £54,000,000 is the estimate of what will be required; £40,000,000 to be spent on the existing lines at the rate of £4,000,000 a year for ten years, and £14,000,000 are to be devoted to the construction of new lines at the rate of £2,000,000 a year for the last seven years of the period of ten years. The

interest on these sums, and the sinking fund for redemption within a period of fifty years, is to be paid out of the revenue from the railways which shows a continual increase. During the first years the Treasury would supply the funds by means of the issue of railway bonds of the nature already indicated, or by other Treasury transactions, unless it should be deemed expedient at a later date to issue special bonds redeemable in fifty years.

THE PROSPERITY OF NEWFOUNDLAND.

During the past decade Newfoundland's imports have grown from £1,247,000 in 1895-6 to £2,141,000 in 1904-5, while its exports have risen from £1,381,000 to £2,222,000 during the same period. During these ten years the imports from Great Britain have increased in value from £412,000 to £553,000, those from Canada in value from £415,000 to £856,000, and those from the United States in value from £411,000 to £572,000. An analysis of the trade returns of the colony, which are only compiled annually, and are not available until the month of March following the fiscal year which they embrace, show that, in the great majority of instances, the import of commodities from Canada had increased at the expense of the United States, a fact attributable in part to the friction arising out of the fishery dispute between Newfoundland and the United States. The prosperity of the island is so stable, and its trade conducted on such conservative lines, that insolvencies, according to a recent report of the United States Consul at St. John's, are rare, and its chief commercial concerns enjoy a high rating with credit agencies. The financial standing of the colony is such that its Treasury reports a surplus of £28,000 for the last fiscal year, making the sixth successive surplus in as many years, out of which the Government has set aside a cash reserve of £90,000, and employed the remainder in adding to the appropriation for public services. The revenues, which are almost entirely obtained from customs duties on imports, have grown in amount in each succeeding year, despite the removal of taxation from fishing, farming, and mining requisites, and from flour, molasses, and kerosene oil, staple necessaries of the masses of the people. In the import trade of Newfoundland, Canada is bettering her position every year in dry goods, woollens, cottons, groceries, hardware, machinery, meats and canned goods, and this to a great extent at the expense of the United States. The catch of cod by the fishermen of Newfoundland during the calendar year, 1905, was larger than usual, because of a short catch by the French, Norwegian, Canadian, and American fishermen. The prices increased to thirty shillings per hundredweight, a figure unrivalled in the modern annals of the colony, and yielding a return of £1,546,000 for the total catch, as compared with £1,281,000 in 1904, an increase in value distributed among the fishing population of £265,000. This is the third highly successful year the colony has enjoyed, the shortage in the Norwegian output of cod liver oil in 1903, enabling the Newfoundland fishermen to market their stock at an increased value, while in 1904 the effects of this were still felt, and largely enhanced the monetary return for the twelve months fishing operations. The winter herring fishery, which important industrial pursuit is chiefly engaged in by Americans in the Bay of Island, on the west coast, took on a new aspect between October, 1905, and Jannary, 1906, owing to the Colonial Ministry withdrawing certain privileges conceded previously to American fishing vessels. In his speech, in opening the annual session of the Newfoundland Legislature, on March 1st, 1906, the Governor thus referred to the subject, "The fishery operations of the people of the United States on the west coast of the colony during the past season, while happily conducted without any breach of the peace, were attended with many vexatious circumstances, my Ministers exercised most commendable forbearance in dealing with the same, and have received the assurance of His Majesty's Government, that negotiations with the Government of the United States have been entered upon with a view to an early solution of the difficulties of the situation. It is hoped that legislation which at present appears necessary will thus be obviated." A new herring fishery policy has been outlined by the Governor's speech in the following terms: — "Realising the vast amount of wealth that is resulting from the herring fishery, and the attention devoted to special methods of cure, in order to encourage our fishing population to turn the herring fishing of this colony to greater advantage than heretofore, my Ministers will submit for your consideration a Bill to provide for the granting of a bounty for herrings that are specially cured and exported." The bounty is to be four shillings and twopence a barrel on all herrings cured on the so-called "Scotch method," and it is proposed to experiment with drift nets in the outer waters to determine if the fish can be secured there, when not further inshore. By this means it is proposed to create an industry which will enable the colonial fishing folk to be independent of the Americans, and make it impossible for the latter to carry on their ndustry in those waters.

COPRA.

Mr. Acting Vice-Consul Trood gives a rather depressing account (Annual Series, No. 3623) of the position in Samoa. Two or three years ago there was a considerable influx of persons abroad seeking land under the idea that planting, though with little capital and not much attention or experience, must prove a successful venture. This has come to an end, and is not likely to be repeated. Now the Government does not allow any person to land intending to settle

in the island unless he deposits £10 to the Custom House, and produces £10 more to show that he has sufficient funds for his maintenance, or is under engagement to a responsible resident for a term of months. Rubber is being planted, but until tapping has begun it is imposssble to say whether the yield from the trees will be good. There is no reason to suppose that it will not be. The labour question continues troublesome. The Chinese labourers, of whom there are about 800 in Samoa, give great satisfaction, but they are not content with the 10s. per month with free board, lodging, and medical attendance they receive, and as the planters will not pay them more it is not likely that many of them will re-engage after their three years engagement has expired. Copra continues to be the only export worth mentioning, and it might be largely increased. Thousands of acres, says Mr. Trood, now lying idle could be turned into cocoanut groves, which 12 or 15 years hence would yield many thousand tons of copra. This copra finds its principal market in Sydney, where it is used by the large soap manufacturers. The native-made article is entirely sun-dried, and averages higher price than that cured in driers. On an average 1,000 cocoanuts turn out 450 lbs. of well dried copra. Before drying each cocoanut weighs about 1 lb. the shrinkage in preparing being about half the original weight. Then there is further shrinkage during the voyage to Sydney of about 4 per cent., and to Europe of 5 per cent. The natives use the cocoanut tree for many purposes, From the husk of the nut they make cinet, used in their house building, The leaves plaited serve for roofing when they cannot obtain the leaves of the sugar-cane, and for enclosing the sides of their houses. Fans and baskets are also made from the leaves.

BOTTLE INDUSTRY IN FRANCE.

In the year 1892, Claude Boucher was forced to close the doors of his bottle factory at Cognac, on account of continuous strikes and exactions of his *employés*. He then set himself to invent a machine for the manufacture of bottles, which would permit him to resume the industry without having to depend upon the human blower. After years of effort, he succeeded in inventing a machine which rests upon an oblong pedestal, and consists of a primary mould in which the shape of the bottle is roughly made, of a cup-shaped mould, which permits a part of the glass which it contains to solidify, a finishing mould, a mould for the neck and mouth, a pipe bringing compressed air to the latter mould, and various levers which permit the opening and closing of these moulds, for opening the valve which supplies the compressed air. The reservoir for the latter is placed some distance away, and is sufficiently large to supply several machines, in one instance as many as twenty. The American Consul at La Rochelle, says that the liquid glass is transferred from the furnace to the machine in the same manner as formerly, by a blower. When a sufficient quantity of molten glass has fallen into the measuring mould, the workman cuts the rope of liquid glass with shears. He immediately applies the compressor, and permits the compressed air to exercise its pressure from above, which causes the liquid to descend into the neck of the mould forming at once the mouth and neck of the bottle. Immediately he reverses this mould, permitting the rest of the liquid mass to flow away from the parts already formed; then opens the mould, and the bottle is seen suspended by the mouth and the upper part of the neck alone; the glass still being very liquid, elongates, and by contact with the oxygen in the open air, a sort of spontaneous combustion is produced, which gives to the glass its brilliancy. When this primitive bottle, bag-like in appearance, has elongated sufficiently, it is enclosed in the various moulds necessary to give the desired consistency to the lower part of the bottle, where the temperature of the glass is considerably higher than in the upper part. It is here that the cup mould comes into play, and compressed air under pressure is introduced. Finally the bottle is enclosed in the finishing mould, where the strongest air pressure is permitted to play in its cavity, and presses the liquid glass against the walls of the mould with such force as to smooth out all unevenness or roughness on the surface. The distribution of the air to all parts of the interior is such that the bottle's thickness is practically uniform in every part of its body. The bottom is next shaped, and the newly manufactured bottle, perfect in form, is put away in a furnace to be cooled, under conditions which will produce in the glass the greatest possible tensile strength. For more than seven years this machine has been in operation, and it has, says the Consul, already passed out of the realm of the experimental into that of the practical. At the present time there are twenty machines in operation at the Cognac factory. The furnace which supplies them contains 300 tons of molten glass. They are capable of producing from 35,000 to 36,000 bottles in twenty-four hours, that is each machine can produce 1,800 bottles in twenty-four hours, and each workman, during his eight hours of labour, produces 600 bottles. The largest number of bottles produced in any one month has been over 800,000. The firm of Martell and Co. use 3,000,000 of these machine-made bottles every year, from this factory. In different parts of France the daily production of bottles by these machines amounts to 250,000 bottles, while in foreign countries the quantity is said to be slightly in excess. The advantages claimed for this system are as follows:—(1) The question of strikes has ceased to be a bugbear to the manufacturer; the operation of the machine is so simple that inexperienced men are thoroughly competent at the end of a week. (2) The great economy in the production of bottles, which is from 60 to 70 per cent. less in cost than by the old method of blowing by mouth. (3)

The bottles are better made, the glass being more evenly distributed in various parts. In a brandy house at Cognac it was estimated that there was formerly a loss of thirty bottles per thousand by breakage of mouth-blown bottles; by the mechanically blown bottles the number is less than three per thousand. (4) Besides greater strength the bottle has a perfect regularity of form and capacity, qualities which are lacking with the ordinary method. (5) A notable advantage from the point of view of hygiene. The mortality of glass-blowers from tuberculosis is recognised to be very great, while as a means of transmitting contagious diseasess, the passing of blowers' pipes from mouth to mouth was most effective. Further, there are said to be certain diseases of the chest which may be attributed directly to glass blowing when found in men engaged in this occupation. The Consul adds that it would appear from what he has seen and learned at Cognac, that the production of bottles, flasks, &c., will be more and more effected by mechanical means.

MADEIRA.

The shipment of Madeira wine to the United Kingdom remains very much the same from year to year. In 1905 Germany took 831 pipes, Russia 1,651, France 1,244, and the United Kingdom only 385. The export would have been much less but for heavy orders from Russia and Germany towards the end of the year in anticipation of the largely increased duties on wine which have since come into force in both countries. These duties threatened to cripple the Madeira wine trade. The tariff on Madeira wine in Russia has always been high. Up to about five years ago it amounted to £21 per pipe, or, say, 9d. per bottle. It was then raised 50 per cent., to £32 per pipe, or, say, 1s. 2d. per bottle, without any appreciable effect on the trade. The new tariff, however, raises the duty to nearly £50 per pipe, or, say, 1s. 10d. per bottle, a duty which, added to the cost of the wine, the freight, and the distributing to merchants, will render the wine so expensive as to be out of the reach of all but the rich. The new German duties are also very high, the rate having been increased from 20 to 30 marks per kilo, gross weight. With all these higher duties, and an additional exchange on the one hand, and no increase of the demand on the other, the outlook for the wine at present is not very promising.

In referring to the matter in his report on Madeira (3638 Annual Series), Mr. Consul Vicars say that he should like to call attention to a wide spread but wholly mistaken notion that all Madeira is sweet, heavy, and "sticky." The so-called "Malmsey" is certainly too sweet and luscious for most palates and constitutions nowadays, but the kind called "Bual" is rich without being either; while the excellent "Seicial" is dry enough to suit any taste. As after-dinner wines both these kinds are unsurpassable in their way, and nothing but the freaks of fashion, Mr. Vicars thinks, can account for their neglect of late years by those who can afford to drink them.

The vintage for 1905 was of average quantity—the crop being estimated at about 8,000 pipes—which is slightly in excess of the requirements of the export trade, added to the local consumption, whereas the 1904 crop amounted to 12,000 pipes, and was largely in excess of the demand. The quality was excellent, the grapes ripening very evenly, and the "must" possessing a fine bouquet and good body. This, however, is rather the rule than the exception in Madeira, for owing to the uniform temperature of the long summer, there is seldom any doubt as to the quality being up to the mark.

THE MINING INDUSTRIES OF PANAMA.

During the Spanish occupation of Panama years ago, gold mining was carried on extensively. What the Spaniards left affords at the present time but small remuneration to the natives and Chinamen. Mining companies have been formed, shares sold, and work begun; but so far, according to the American Consul at Colon, with very few exceptions, there is little to show for the money and time spent in conducting these mining operations. Gold quartz in pockets is found in numerous places in the Republic but, owing to the excessive volcanic disturbances that have occurred, the geological formations show that unvarying strata of ores rarely, if ever, exist; that mineral veins, through volcanic eruption processes, have been broken, and fragments deposited in various levels of the earth, some at higher, others at lower, depths, and often at a great distance from the mother vein. These deposits are so small and scattered, says the Consul, that it does not pay to hunt for them or work them when once found. He adds that he knows of only one gold mine which works gold quartz that is a paying investment. This mine is in the Province of Panama, on the Pacific side of the Republic, and has been worked for some years. On the Isthmus of Panama there are no gold mines in operation, and none have been worked since the mine at Santa Rica, in the Province of Colon, which hardly deserves the name of a gold mine, was abandoned after a considerable amount of money had been sunk in the venture. In recent years valuable deposits of manganese were found near Nombre di Dios, in the Province of Colon, and certain American investors organised the Manganese Mining Company which paid large dividends, until forced to close down by a depression of prices in the home market. Most of the coal is shipped to Panama from the United States, a small portion being imported from Australia by the Pacific Steam Navigation Company. Coal beds or veins are to be found in many parts of the Republic of Panama. In the Province of Bocas del Toro, a very good description of bituminous coal was

discovered, but it was so far back in the interior that it was not a paying investment. In the Isthmian Canal zone, veins were found by the French during their occupation of this territory. This statement seems to be verified by the re-opening of an old coal bed on the Negrito River. Samples of this coal, which were shown to the Consul, appeared to him to be of lignite formation. Recently two other places on the same property, but at a lower level, were bored, and it is reported that a coal stratum three feet thick was discovered. According to semi-official reports, beds of gold, silver, copper, lead and cinnabar, exist in the districts of Cocles, Veraguas, Chiriqui and Panama.

CADIZ.

Cadiz is almost an island, a fortress surrounded on all sides by a wall through which there is a gateway into the town. Beyond this entrance stretches a long, narrow belt of sand, dividing the Atlantic from the bay. It is a unique geographical position, and it is impossible within the town limits to extend the available building area. The people of Cadiz have shown no desire to extend it until recently. Other towns, notably Saville, have gradually drawn to themselves the trade which formerly Cadiz owned, and the people of Cadiz have been content. But now they are begining to stir a little, and they have decided to demolish a certain portion of the picturesque but now useless walls in order to obtain space for erecting factories, and developing the business portion of the town. Gardens, too, are to be laid out, and modern hotels built. It is proposed to utilise the material obtained in lengthening existing piers and reclaiming land from the sea, thus enabling vessels to land and discharge cargo alongside of wharves instead, as now, by means of lighters in the often ruffled waters of the bay. In the prevailing distress through lack of employment, says Mr. Consul Keyser (No. 3607, Annual Series), local authorities and influential merchants have found opportunity to bring forward their scheme and the walls are already being demolished. It is hoped to convert Cadiz into the European port for South Africa in the same manner as Brindisi has been for the East. But the Cadiz of yesterday (says Mr. Keyser) is the Cadiz of to-day, and time shows few changes. "Local customs and their requirements create no new wants, and what sufficed in the past is also sufficient for the present. Centres of trade have become established elsewhere, while Cadiz and her sister towns on the bay have not cared to compete. Beyond slowly moving trains on a single main line the only means of communication is by old-fashioned diligencies, wagons, and mules." But now there are signs of activity and promise of new energy in a seeming desire to march with the times. Anyway the town wall is in course of demolition, and the first step in the direction of change and development is generally the most difficult.

ARTS AND CRAFTS.

Coloured Exterior Decoration.—It has been the rule to take it for granted that in smoky London, and in other large manufacturing towns in this country, our buildings must be more or less smoke coloured. We have grown accustomed to the somewhat dreary monotony of the colour (or want of colour) of our streets, and ceased to look for anything fresh. Those of us who, after travelling abroad, have become aware that such a thing as polychromatic exterior decoration really does exist, have been wont to say with a shrug that that kind of thing looks very well in a bright atmosphere, or in a dry climate, but, after all, what can be done in the English damp and grey? Terra-cotta speedily becomes so dirty that it hardly tells as colour; and stone soon loses all trace of its original hue; even granite, if it is not polished, becomes in time as grimy as the rest; while, as for paint and other forms of surface decoration, the less said the better about them after they have been up a little while. We must, we declare, just resign ourselves to the inevitable, and put up with the dinginess of our surroundings as best we may, and frankly own that, owing to our unfortunate climate, all beauty save that of form must be denied to us. This attitude may not be very cheering or very helpful, but it is certainly common. The great revival of interest in municipal affairs which has taken place of recent years has made the question of the aspect of our streets, in London and elsewhere, a far more burning and more popular one than it used to be. People have awakened to the realisation that even in England, and in a manufacturing city it is possible to consider the appearance of the town as a whole and to erect buildings which have some other merit beyond that of being adequate to the purely utilitarian requirements of the business to be carried on in them. Various efforts have been made, and are being made, both by public bodies and private individuals to better the existing state of things, and one of the rather tentative attempts to get away from the influence of the all-pervading dirt has manifested itself in the use of coloured glazed tiles in exterior decoration. Of course, glazed tiles or bricks were employed in the East before the days of Darius, and have been a more or less common form of wall covering in different parts of the world through the course of the centuries; but the use of such coloured tiles or bricks, as well as of what is known in the trade as "faience" (*i.e.*, friezes, capitals, &c., made in clay and coated with a coloured glaze or enamel), for exterior decoration, is an innovation in this country. For some years past, plain salt-glazed bricks have been used in increasing quantities in the building of warehouses, &c., and though the tone of such bricks is naturally very much restricted as to range, they sometimes make quite fine colour, and they generally at least hold their own amongst the surrounding unglazed brick and stone. Again a regular method of

decorating the exterior of public houses and eating-houses nowadays is to employ coloured tiles, sometimes in a plain or mottled colour, sometimes painted with landscape or figure subjects. The colours used are naturally at times more gaudy than beautiful, and the pictures may not always be models of what pictorial ceramic art should be, but few people will be prepared to deny that, taking it all round, and in spite of the pretentiousness of some of the decoration, the result is less shabby and squalid in appearance than the old-fashioned public house exterior. If we turn to buildings of more importance, and greater pretentions, we find that coloured glazes have begun to take a place, and at times a very important place, in their adornment and decoration in London, Manchester, and other large towns. A most successful instance in London is the porch of the children's hospital in the Waterloo-road. This porch, the gift of Mr. Lewis Doulton, is entirely built up of glazed ware in a broken green colour strongly reminiscent of serpentine. It is an important structure, and is quite a feature not only of the hospital buildings, but in the street, and the effect of the mottled green surface is most satisfactory. Again, the Savoy Hotel is not only roofed with brightish green tiles, but it is faced on the Strand side with enamelled terra-cotta slabs. The pinkish body colour grinning, more or less, through the opaque white tin enamel with which it is coated, produces a very pleasing variety of tint, and the effect of the long line of building covered with delicate colour rather of the quality of the inside of an oyster shell, is quite charming enough to make the passer-by regret that the point of view from which he can see it best is the top of an omnibus. There is here nothing very pronounced in the way of colour, but what colour there is tells, and that after some years of London smoke, and without the aid of patent cleaning apparatus.

A Coloured House.—It is now rather over four years since Mr. Halsey Ricardo read a paper before the Society of Arts on "The Architect's Use of Enamelled Tiles," in which he contended vigorously for the use of glazed tiles and bricks in exterior decoration, not merely as patches of colour, but as the covering of the whole building, and stated that while he would like to see "whole streets treated in permanent colour" he hoped "to see the scheme tried on a detached building standing free and with some trees about it." It is not many people who have the chance of realising their own hopes so completely as Mr. Ricardo has been able to do. It has fallen to his lot to build a house in Addison-road which answers to his requirements in all particulars. It is detached, it stands free, and it has a background of trees. On the other hand, if the opportunity has been offered the architect has not shrunk from taking it, and has put his theories into practice with thorough-going completeness. The exterior from roof to basement is covered with glazed bricks and enamelled blocks. The main surfaces are coated with coloured glazed bricks, whilst the pilasters, which are a feature of the side elevation, as well as the mouldings of the arches and the other architectural details, are in blocks of enamelled terra cotta, and a certain amount of the same material is introduced into the wall space, more especially in the front of the house, where the opaque whitish colour is broken by bands of yellow green slabs. The bricks used are not coated with tin enamel merely but with brilliant glazes. The lower portion of the house is in fnll rich green, the spandrils between the arched windows and the square lines of the pilasters and cornice in deep blue and the storey above the cornice in rather lighter blue. The very chimney stacks are of bright blue bricks edged with enamelled terra cotta. The colour scheme sounds startling enough, but there is nothing staring about the general effect, for the bricks, whether by accident or design, have been so placed as to present a large surface of flat unbroken colour, and in places they vary in tint quite considerably, whilst in the top storey two shades of blue seem to have been employed deliberately. The roofing tiles, too, have been carefully considered, and like those on the Savoy Hotel, are bright green, a colour which, though one sometimes meets it abroad, is still quite uncommon on this side of the Channel. Altogether the house is strikingly unlike the ordinary "detached residences" which surround it; but its character is its own, and it does not look, as we might naturally expect such a building to do, like a bit of Eastern, or even of Italian or Spanish building planted in a Western or English *milieu*. It holds its own as different from its neighbours, as a trifle strange it may be, but not as a foreign product; and it is a remarkable experiment in a type of building hitherto unknown in this country. The problem of coloured exterior decoration has been before us for some years. Mr. Ricardo has attacked it with energy and discretion. The lead having once been given, it remains to be seen if it will be followed up.

Doulton Ware. — Messrs. Doulton and Co.'s recent show at the New Dudley Gallery afforded an opportunity of seeing the latest achievements of the firm. The exhibits included not only the most modern developments in their Lambeth stoneware, in which they are now introducing rather a new range of colours, but also their newest products in earthenware, made at Burslem. Perhaps the most striking part of the exhibit was the collection of bright red *flambé* vases, so vivid and so unbroken in colour that the black figures and landscapes painted on them were a welcome relief to the general brilliancy and evenness of their tone. The quality of the red is wonderful, and quite unlike ordinary *flambé*. The most surprising, and in some ways the most interesting things shown were some experimental pieces of salt glaze lustre ware. If such ware can be produced in the ordinary way of business it should prove a very welcome addition to the possible means of decorating stoneware.

GENERAL NOTES.

Schools in Palermo.—In his report on the trade of Sicily for 1905 (3595 Annual Series), Mr. Consul Sidney Churchill refers to the action of the Municipality of Palermo in making provision for luncheons for children whose parents were unable to provide them. This new departure seems to have been induced by the desire to make the Communal Schools more attractive in view of the institution in Palermo of expelled French Congregational ecclesiastical establishments. It is estimated that there are now some 35,000 children in the municipal schools, and the portion for whom food would be provided is calculated to be from 4,000 to 5,000. This food consists of 140 grammes of municipal bread and some chocolate, alternated on other days with sausages, cheese, and dried fruits, at an average daily cost of nine-tenths of a penny per head.

Trade of Iceland.—Reference was made last year in the *Journal* to the use of motor boats by the Icelandic fishing industry, and Mr. Consul Vidalin, in his report on the trade and commerce of Iceland for the years 1903-5 (No. 3570, Annual Series) says that during last year the number of these boats greatly increased, some of them being built in Iceland itself, besides a good many bought from Denmark. Most of these boats are open, but some of them are decked, which is necessary if they are to be used for the deep-sea fisheries. The experience hitherto obtained from the motor boats is fairly satisfactory as far as the fisheries are concerned, several of them having got a pretty good catch. Another new feature in the deep-sea fisheries of Iceland is the acquisition of two steam trawlers. Both these vessels were bought second-hand from the United Kingdom. One of them did well during the winter season, whilst the other, not starting till July, turned out a failure. How far it will pay to encourage steam trawlers in cod fishing for curing salt fish for the (Spanish) market, is difficult to foretell. The result at any rate will be doubtful in case the prices of the salt fish fall considerably, which may always be expected.

Camphor.—In his report upon the trade of Formosa (No. 3646, Annual Series), Mr. Acting-Consul Crowe says there was a considerable shortage in the production of camphor last year, due, to a certain extent, to the fact that the more easily accessible trees have been nearly all cut down, while head hunting savages are still powerful enough to prevent camphor workers from advancing far into the forests. Some camphor districts also shut down because the prices paid by the Monopoly Bureau did not cover expenses. In order to remedy this state of affairs the Camphor Bureau authorities decided to increase the price in nearly all the producing districts, and this was done in February of this year. The average increase for the ten districts represents about 4s. for camphor and 2s. for camphor oil per picul (133⅓ lbs.), the largest increase being for the camphor from Shinchiku, for which an additional 13s. will be paid, while 6s. will be added to the former price of oil. It is also reported that the sum to be expended in policing the savage border, which was over £50,000 last year, is to be increased.

Trade with Beira.—In his report on the trade of the consular district of Beira for last year (No. 3568, Annual Series), Mr. Consul Maughan complains that British manufacturers are allowing the trade to slip from them, and to pass into the hands of producers whose opportunities of monopolising the market are in no way superior to ours. He says that more commercial travellers are wanted in East Africa, men who not only offer the best makes of goods obtainable, but also those cheaper qualities, made in close imitation of them, of which Germany at present makes such a striking speciality. It must be remembered that retailers in this part of Africa are general store-keepers, those of lesser importance in many cases ignorant of home cost, and prepared to pay slightly enhanced prices from the moment they see their margin of profit assured. A travelling representative of a fairly wide group of manufacturers, armed with a well illustrated catalogue, and speaking the languages of the coast, can thus even yet, if he be a capable salesman, effect considerable sales. For houses here who expect business to result from the dispatch of catalogues and printed matter, there is no hope whatever.

Grape Farming.—Some remarkable figures are given by Mr. Consul Haggard in his report on the trade of Malaga (No. 3644, Annual Series) as to the profits to be derived from grape farming in Spain. Mr. Haggard refers to the export grape for British, American, and other markets, and he assumes close and assiduous attention, coupled with a thorough knowledge of the cultivation in all its varied details. The particulars he quotes are those of a person engaged in the industry in whose statements he had complete confidence. He takes a hectare of land, equal to about 2½ acres, already planted with the vines at the full producing stage. It contains 300, set in rows, and at a distance from each other of from 19 to 20 feet. For this field about 200 posts of pine, or other suitable timber, are required for fixing the network of galvanised iron wire on which the branches are trained, and by which they and the fruit are supported. These poles are about seven feet in length, and the trunk of the vine which is kept clean and free from branches, is allowed to grow to a height of from 5 to 6½ feet. Mr. Haggard gives the particulars of the cost of labour, value of the produce of the 2½ acres, and so on. The total charges, including £17 4s. 4d. for wages, £58 10s. for oak barrels, £17 6s. 8d. for cutting, cleaning, packing, and so on; £6 1s. 4d. for carriage to port and shipment of the barrels; and the Government tax on land, £10; amount to £125 12s., and the net value of the produce to £316 3s. 4d., which leaves a net profit of £190 11s. 4d. upon the 2½ acres.

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FRIDAY, JULY 13, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CHAIRMANSHIP OF COUNCIL.

On Monday, 9th inst., at their first meeting the Council elected Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., as Chairman for the ensuing year.

COUNCIL.

At the last meeting of the Council on Monday, 9th inst., Sir John Wolfe Barry, K.C.B., F.R.S., was elected a Vice-President of the Society in place of the Duke of Westminster, who is unable to accept the office to which he was elected at the Annual General Meeting on the 27th ult.

EXAMINATIONS.

The results of the Advanced Examinations (Stage III.) have just been published, and copies sent to all centres for distribution to candidates.

The results of the Intermediate Examinations (Stage II.) will be published about the end of July or early in August, and those of the Elementary (Stage I.) towards the end of August or early in September.

PRACTICAL EXAMINATIONS IN MUSIC.

The practical examinations in Music were not concluded this year until the 5th July, too late for the results to be included in the Report of the Council. They lasted for 13 days.

The examination was conducted by Dr. Ernest Walker, M.A., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 477 candidates entered, and of these 467 were examined, an increase of 49 as compared with last year. There were 394 passes and 73 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, viola, and bassoon. 383 entered for the piano, 320 of whom passed; 57 entered for the violin, of whom 48 passed; 6 entered for the violoncello, all of whom passed; 18 entered for singing, of whom 17 passed; two entered and passed for the viola, and one for the bassoon. No medals were awarded.

The Examiners report that, on the whole, the general level of attainment was rather higher this year than last, and the number of failures was proportionately less. Some admirable work was shown, especially among the violinists. Sight-reading was, however, a weak point with nearly all the singers, and a good many pianoforte candidates need to be reminded that mere accuracy of notes will not carry them very far, unless it is combined with good touch and tone and careful attention to phrasing.

EXAMINATIONS.

The following is the Time Table for 1907:—

	Monday, April 15. (7—10 p.m.)	Tuesday, April 16. (7—10 p.m.)	Wednesday, April 17. (7—10 p.m.)	Thursday, April 18. (7—10 p.m.)	Friday, April 19. (7—10 p.m.)
Advanced Stage.	Book-keeping. English. Economics. Danish and Norwegian.	Arithmetic. Commercial Law. German. Italian. Spanish.	French. Commercial History and Geography. Typewriting (7.30 to 10 p.m.).	Accounting and Banking. Shorthand (7.15 to 10 p.m.).	Portuguese. Précis-writing. Russian. Swedish. Chinese. Japanese. Hindustani.
Intermediate Stage.	Typewriting (7.30 to 10 p.m.). French. Danish and Norwegian. Commercial History and Geography.	Book-keeping. Précis-writing.	English. Economics. Spanish.	Arithmetic. German. Portuguese. Italian. Russian. Chinese. Japanese. Hindustani.	Swedish. Shorthand (7.15 to 10 p.m.).
Elementary Stage.	Handwriting and Correspondence. French.	German. Italian. Typewriting (7.30 to 10 p.m.).	Book-keeping Spanish.	Shorthand (7.15 to 10 p.m.).	Commercial Geography. Arithmetic.
Music.		Harmony.	Rudiments of Music (7 to 9 p.m.).		

The last day for receiving entries is March 12.

The special subject for Commercial History and Geography is:—The United States of America.

FRANKLIN COMMEMORATION.

The American Philosophical Society have forwarded to the Society of Arts an example of the Medal struck to commemorate the 200th Anniversary of the birth of Benjamin Franklin. One hundred and fifty impressions of the Medal have been struck under the provision of an Act of Congress.

The obverse of the Medal has a fine head of Franklin, with the inscription below it: "Printer, Philosopher, Scientist, Statesman, and Diplomatist;" while on the reverse is an allegorical group in which the muse of History appears to be recording a report made to her by Literature, Science, and Philosophy.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

MODERN WARSHIPS.

By Sir William White, K.C.B., F.R.S.

Lecture III.—Delivered February 12th, 1906.

The principle of "concentration" of armour and armament received its fullest illustration in the design of the *Inflexible* and four other central-citadel ships. Action taken by the French rendered a change of type necessary before the *Inflexible* was ready for service. For nearly ten years (from 1869) the most powerful British battleships had been armed on the turret system, and had carried four heavy guns possessing great horizontal arcs of command, but placed at a moderate height above water. The "floating gun-carriage" idea had governed the designs; fighting efficiency in rough water at sea had been

diminished in consequence of the desire to increase thickness of armour and to diminish area of target. There was no secondary armament worth consideration even in later ships of the central-citadel type.

When a new departure was made in France after the close of the Franco-German war, designers seized upon the weak points of the English system and constructed vessels in which the principal armament was mounted at a great height above water; barbettes were substituted for turrets, and a numerous secondary armament of comparatively light guns was carried at a lower level, where they were comparatively free from interference from the blast of the heavy guns. Fighting efficiency in a sea-way was greatly increased by these changes, but in order to keep within moderate dimensions, the area of armour protection was greatly diminished. The French system limited vertical side-armour to a narrow "waterline belt," extending from 5 to 5½ feet under water to 18 inches or 2 feet above water. A strong protective deck was fitted at the top of this armour belt, and protection of vitals was thus secured; but protection to buoyancy and stability was very limited. The heavy guns of the French ships were mounted in shallow armoured barbettes, and the ammunition was passed up through armoured tubes. The secondary armament was entirely unprotected.

This limitation of protected areas offered an extreme contrast to the contemporaneous British system. Ships of great freeboard, with their armaments placed high above water, proved capable of efficient fighting in weather which prevented the use of low-placed turret guns. On the other hand, in many of the French ships when completed (owing to additions made during construction), the narrow armour-belts were almost submerged when the ships were fully laden. The thin sides above the armour-belt could be riddled by the lightest guns, and large quantities of water would then be admitted above the belt-decks, thus prejudicing buoyancy and stability and involving grave risks of capsizing. A striking illustration was thus afforded of the rival claims of offence and defence, as well as of the influence on designs of limitations in dimensions and displacement. Limits of size and cost as then fixed made it impossible to provide a combination of great powers of offence and defence in a single vessel. The French made their choice in favour of great offensive power, whereas in British battleships defence was the predominant quality and offensive power in rough water was diminished in order to keep down dimensions.

The French challenge could not be ignored; it led to the design of the *Admiral* class in 1878. An upper limit of cost was fixed; it became necessary, therefore, to follow the French idea and to accept diminished protection to buoyancy and stability in the form of narrow waterline belts. In the *Admiral* class these belts extended over about 45 per cent. of the extreme length; the ends were left unarmoured, were subdivided minutely, and were used for the stowage of coals and stores as in the *Inflexible*. Precautions were taken in the structure above the armour belts to assist the preservation of buoyancy and stability. Cellular sides, minute watertight subdivision, and stowage of water-excluding materials were important features in the *Admiral* class, to which there were no corresponding features in French designs. The British barbettes gave better protection than the French to the loading arrangements of the heavy guns and to their mountings. The secondary armament consisted of more powerful weapons; and the disposition of the armament was superior. The French eventually adopted the English disposition for the principal armament, and it is interesting to add that this change was made at a time when certain English writers were strongly urging the propriety of our adoption of the French system.

The limitation of the area of armour-protection on the sides of battleships naturally led those concerned with the design of offensive weapons to devise means for effecting the rapid destruction of unarmoured or lightly armoured superstructures. From 1875 to 1885 the development of quick-firing guns made rapid progress: first of small calibres (up to 6-pounders) and later of larger calibres. High explosives were also studied with a view to increase in destructive effect of shell fire. The chemist began to play a more important part than heretofore in naval armaments. The fundamental idea underlying all these changes was the rapid destruction of unarmoured above-water portions of warships in order that the vessels might be made unmanageable or brought into a dangerous condition, apart from perforation of the armour. Concurrently efforts were in progress for improving the quality of projectiles as well as the power of guns. The use of chrome steel instead of chilled cast-iron for projectiles enormously in-

creased penetrative power, and made it necessary to adopt "hard-faced" armour. It was essentially a period of transition in battleship design, and differences were accentuated by the fact that the abandonment of muzzle-loading guns in favour of breech-loaders involved many experimental investigations and considerable delays in the completion of ships.

During the construction of the *Admiral* class conditions prevailed similar to those which had occurred in building the *Inflexible*. The design of the guns was not settled until long after ships had been taken in hand; in some instances radical changes in the principal armaments were made after ships were far advanced in construction. Designs had to be modified, quick-firing guns were added to meet the attack of torpedo craft, then becoming a formidable menace, and considerable additions were made to the weights of armaments originally contemplated. As a consequence, the ships when completed were heavier than as first designed, and their armour belts were more deeply immersed. The only consolation possible during this difficult period was the knowledge that foreign rivals were in no better case; indeed greater excesses in draught and longer delays in construction occurred abroad, and the relative position for ships of the Royal Navy compared favourably with that of foreign ships. But the lesson learned during this period should never be forgotten. Rapidity and economy of construction and the fulfilment of the intentions of warship designs can only be ensured when all questions relating to armament and other important features have been settled before the work of construction is begun. Changes in armament, in particular, involving serious and costly alterations, cannot fail to prejudice in some respects the merits of designs, and to retard the completion of ships.

A new chapter of naval history began in the year 1885, when a special programme of construction was introduced by Lord Northbrook as the result of a considerable public agitation for an increase in the fleet. Two first-class battleships were built under this programme, one of which was the unfortunate *Victoria*. They carried two of the largest breech-loading guns ever mounted, each weighing 110½ tons. The turret containing these two guns was placed well forward; its base was protected by a heavily-armoured redoubt (or breastwork) standing upon the protective plating of the belt deck, which was only about three feet above water. The armour belt was similar in character to that which had been fitted in the *Admiral* class, extending over nearly one-half the length. The unarmoured ends were protected by a strong steel under-water deck, and the spaces above it were minutely subdivided. The two heavy turret guns had a horizontal arc of command of about 300 degrees. The stern-chase gun was of 10-inch calibre protected by an armoured shield. Apart from the concentration of the two heavy guns in a single turret, a novel feature in the design was the introduction of twelve 6-inch guns mounted on the upper deck within a battery extending from the turret to the stern, the sides of this battery being protected by thin armour. This type of battleship was never repeated. The deficiency in powerful stern fire, and the limitation of the arc of command of the heavy guns, were recognised to be undesirable features.

In 1886 two other battleships were laid down (the *Nile* and *Trafalgar*) in which the general arrangement of the turret armament was similar to that of the *Devastation* class. Four 67-ton breech-loading guns were mounted in two turrets placed at the middle line. The bases of the turrets were protected by a breastwork extending the full width of the ship, with 18-inch armour on the sides. Armour of the same thickness was also used to protect the turrets. The total weight of protection in this class of vessel was 35 per cent. of the displacement. Amidships, between the turrets and above the upper deck, a short lightly-armoured central battery was built. It originally contained six 4·7-inch guns, which have been replaced by 6-inch guns. This reversion to moderate freeboard and low-placed turret guns was the last application of that principle of design in British battleships. In smooth water the *Nile* and the *Trafalgar* are undoubtedly powerful fighting machines, but they are ill-adapted for ocean work.

From 1886 to 1889 no new battleship was laid down for the Royal Navy. A large number of incomplete ships were in various stages of construction and it was necessary to devote available resources to their completion. It was beginning to be recognised that there must be a due proportion between the annual grant for new construction and the total outstanding liability on new ships if they were to be completed in a reasonable time. This simple principle had been obscured by delays consequent upon changes in naval armaments; such as the introduction of breech-loading guns, quick-firing guns, locomotive torpedoes,

and improved qualities of armour. During this period there was a disposition in some quarters to regard the construction of armoured ships as a chapter in naval history drawing to its close. As a matter of fact, this period of suspension in laying down new battleships was only a prelude to the commencement of programmes of construction exceeding in magnitude all that had gone before.

Public opinion was the primary cause of greater activity. Parliamentary representatives of the Admiralty made no secret of their opinion that the simultaneous construction of large numbers of ships was undesirable, and must involve a large increase in expenditure on ships and armaments. It was also urged that by laying down a few ships at one time advantage could be taken of improvements which were continually being made in war *materiel*. The public mind could not be quieted, however, and the Government took action by bringing in the Naval Defence Act of 1889. This Act provided for the construction within five years of 10 battleships, 9 first-class cruisers, 33 second and third-class cruisers, and 18 torpedo gunboats. The first estimate of cost for this new fleet was about twenty millions sterling; the ultimate cost became twenty-one and a-half millions sterling, chiefly in consequence of subsequent decisions to increase the power and cost of certain ships. It was decided to charge ten millions of this outlay to a special loan to be met by terminable annuities. The balance of expenditure was borne by the ordinary Navy Estimates. Grave doubts were expressed in well-informed quarters as to the possibility of carrying out this programme in the stipulated period of five years, and obtaining the large supplies of armour, armament, gun-mountings and other mechanisms. Considerable difficulties had to be faced and surmounted, but thanks in great measure to the enterprise of private shipbuilders, engineers, and steel-makers success was achieved. The work was carried out practically within the time named, and the effort resulted in an enormous addition to our naval force, in ships provided with modern equipments, guns, gun-mountings, armour, and propelling machinery.

It may be of interest at this point to summarise briefly the progress made in the manufacture of armour in Great Britain since the ironclad reconstruction began. At first, soft iron was considered the best material, and armour plates were hammered or forged. The plates were of small size and moderate thickness. The process of rolling soon proved superior to that of forging under steam hammers; the necessary rolling mills were provided and developed in power as the demand arose for thicker plates. The great French firm of Schneider, of Creuzot, did most to make steel armour a rival to iron: and extensive trials of this armour were carried out at Spezzia by the Italian naval authorities. It was shown by these trials that steel was superior to iron armour in resistance to penetration by the projectiles of that period, but was much more liable than iron to crack under the impact of comparatively light projectiles. In order to combine increased resistance with freedom from through-cracking, English armour-plate makers then produced "compound" armour, which had a hard steel face supported by a tough iron back. The hard steel face proved capable of resisting penetration by the best projectiles then available; the tough iron back prevented through-cracking when penetration did not take place. When the *Inflexible* was building, compound armour was in the experimental stage; the manufacture was sufficiently advanced to permit of the turret armour being made of the new quality, while the hull armour was of iron, fitted (as above stated) in two layers, each twelve inches in thickness. For about ten years, compound armour was used almost exclusively in British armoured ships, while steel was chiefly used in France. Each quality of armour had its advocates. On the whole with equal thickness there was about equal defence. In 1888, on the initiative of the lecturer, it was decided by the Admiralty to begin a new series of experiments on armour in order to determine the possibility of producing steel armour capable of defence against the attack of chrome steel projectiles moving at high velocities. The great steel makers of the country were appealed to, and in response produced "all steel" armour of superior quality to any that had been previously made. At the same time the question of alloying some of the rarer metals with steel was experimentally investigated. From this series of experiments arose a great development of armour manufacture. Two new firms (Messrs. Vickers and Messrs. Beardmore) were added to the list which had previously contained only the names of Messrs. Brown and Messrs. Cammell of Sheffield. More than 30,000 tons of armour were required to be delivered for ships of the

Naval Defence Programme, and it was necessary to have this delivered in about three years. The total output of the two Sheffield firms was then 8,000 tons. It, therefore, became necessary, even with assistance rendered by the two new firms, to commence the manufacture of armour at a very early period and to make the "moulds" by which the plates were shaped before ships were in existence. This was a departure from previous practice, under which moulds were made at the ships themselves. The proposal of the lecturer to adopt this novel procedure was questioned by many practical shipbuilders; it proved not only feasible but advantageous and has since been generally adopted.

The next step in the improvement of armour was the introduction of the "Harvey" process. Steel armour plates are made from ingots and in their first condition are of uniform quality throughout. In the Harvey process the faces of the plates are first hardened by carbonising (or "cementing), and finally tempered by means of a sudden chill. This process had been experimented with previously at Sheffield in the works of Messrs. Brown, but it had been set aside because the hardened material proved almost intractable. Mr. Harvey, in America, pushed the matter further with the active assistance of the Navy Department, and produced experimental plates of excellent quality. It became necessary, therefore, to consider the adoption of his methods. For this purpose arrangements were made with the Harvey Company of America, and experimental plates were manufactured at Sheffield. The results proved superior to anything that had been obtained in America up to that date; the necessary reconstruction of the plant was immediately undertaken in British armour-plate works, and supplies of Harveyised armour were obtained as soon as possible. These plates proved superior in resistance to perforation to compound or steel plates previously used, and were not liable to serious cracking; consequently less thicknesses of armour were needed to secure a desired defence, and with a given weight of armour greater areas could be protected.

Further improvements in armour-plate manufacture were made in 1895 by Messrs. Krupp, and were based on researches into the effect of "heat-treatment" upon steel alloyed with other metals, and particularly with nickel and chrome. In these researches English investigators had taken an important part, and the late Sir William Roberts-Austen had devoted great attention to the matter on behalf of the Institution of Mechanical Engineers. Resistance to perforation and toughness were both increased by the Krupp modification of the Harvey process, the benefits being greatest in plates of considerable thickness.

The effect of these successive improvements in the quality of armour may be summarised as follows:—Taking 15 inches of iron as a standard thickness, the same defence could be obtained with 12 inches of compound or ordinary steel armour; later with 7½ inches of Harveyed armour; and finally with less than 6 inches Krupp armour. This great reduction in thickness for a given defence has had a remarkable influence upon warship design, and has enabled greater areas to be protected effectively without exceeding the percentages of the displacement ordinarily assigned to armour in battleships and armoured cruisers. When quick-firing guns and high explosives were introduced, the "shrinkage" in protected area that had been proceeding for many years, as the power of guns increased, was necessarily arrested and a return was made to earlier practice, considerable areas of the broadside being armoured. One of the first illustrations of this change was given in the French armoured cruiser *Dupuy de Lôme*, designed about 1887. She was protected with thin steel armour over the whole broadside above water and down to a few feet below water, just as the first ironclads had been protected. In this manner it was intended to compel the detonation outside the armour of shells carrying large charges of high explosives, and this was accomplished. But with the thickness and quality of armour then used, enormous damage could be done to the thinly armoured sides by cheap "chilled" cast-iron projectiles of the *Palliser* type. For this reason this system of protection was not adopted in the Royal Navy; nor were "armoured" cruisers built until Krupp's improvements enabled large areas to be covered with armour of sufficient thickness to withstand the attack of armour-piercing projectiles from 6 inch quick-firing guns at fighting ranges.

It will be understood that these improvements in armour were not carried out without considerable expenditure on plant, appliances and experimental investigations, and the cost per ton of armour was correspondingly increased. On the other hand the size and cost of vessels was greatly reduced, as compared with what would have been required with armour of the earlier qualities to secure equal defence. As an illustration of the cost of

plant for the manufacture of armour, it may be stated that at least half-a-million sterling must be spent in establishing a modern armour-plate factory having an output of from 8,000 to 10,000 tons per annum. The rapid changes made between 1888 and 1898 also compelled proprietors of established armour-plate factories to incur large capital expenditure on modifications and extensions of plant. These are facts which ought not to be overlooked; the enterprise of private firms has been of great national advantage. Apart from it our large programmes of naval construction could not have been executed within the periods that have sufficed. The magnitude of the changes effected will be realised when it is stated that in 1889 the total annual production of armour in the United Kingdom was about 8,000 tons, whereas at the present moment the corresponding output is not less than 40,000 tons, and on an emergency might be even greater. Messrs. Armstrong and Whitworth now stand in the first rank of armour-plate makers with the firms named above.

The naval defence programme of 1889 was based on a reconsideration of the principles of design for British battleships. The Admiralty called into council a number of naval officers, whose experience and ability made their advice of great value, and placed before a Special Committee, which included those gentlemen and the members of the Board, alternative designs. These designs were carefully considered and compared, before the types which best fulfilled existing conditions were selected. Particulars of this procedure can be found in Parliamentary papers of that date. The selected type of battleship is known as the *Royal Sovereign* class, which exceeded in dimensions, speed, offensive and defensive power, all preceding battleships. The fundamental idea of the design was increased fighting efficiency and superior maintenance of speed at sea. The vessels were of high freeboard throughout their length. The principal armament consisted of four 67-ton guns, mounted in pairs in armoured barbettes placed towards the bow and stern at a considerable height above water. The armour on the barbettes was 17 inches thick; that on the hull included a water-line belt extending about two-thirds of the length, with transverse bulkheads at the extremities. The maximum thickness of armour on the belt was 18 inches, and the belt deck was covered with strong steel plating. The unarmoured ends were of less extent than in preceding battleships, but were similarly subdivided. No coal was carried at the extremities above the under-water protective deck; the spaces were assigned to stores and equipment. Between the belt and main decks the sides were lightly protected, by armour equivalent to 5 inches in thickness, throughout a considerable portion of the midship length; oblique armour bulkheads carried this protection on to meet the strongly-armoured walls of the barbettes, the bases of which stood upon the belt deck In this manner the central portion of the vessel was protected to a height of from 9 to 10 feet above water against the attacks of quick-firing guns and high explosives. The secondary armament consisted of ten 6-inch quick-firing guns, those on the main deck being protected by armoured casemates (or isolated batteries), and those on the upper deck by shields. The guaranteed speeds were $17\frac{1}{2}$ knots maximum for short periods, and $16\frac{1}{2}$ knots with natural draught. These speeds were exceeded on trial. The coal supply and bunker capacity were much in excess of what had been previously accepted for battleships, and gave to the vessels extraordinary power of keeping at sea. The length (380 feet) was the same as had been adopted for our first sea-going ironclad, the *Warrior*, but the beam was increased to 75 feet as against 58 feet in the *Warrior*; this increase in beam was required to give adequate stability. The displacement was 13,800 tons—about 1,800 tons in excess of the displacement previously accepted for battleships of the Royal Navy—but was less than that which the Italians had accepted for battleships many years before. The cost of the *Royal Sovereign* was about £780,000, or £30,000 less than the cost of the *Inflexible*, which was of 12,000 tons displacement, and 14 knots speed. In some quarters it was maintained that these large vessels would be difficult to handle; experience has disproved this opinion and shown that they are handy and efficient in fleet manœuvres. In one of the eight vessels of the class it was decided to adopt turrets instead of barbettes. In order to provide for the additional weight involved by the turret system, moderate freeboard was adopted at the extremities, and the turret guns were placed at considerably less height. The other arrangements for protection — armour belt, central battery, casemates, &c.—were identical with those of the barbette ships. Experience has shown that the heavy armament of the turret ship is not nearly so efficient at

sea as the higher placed barbette guns, and the power of maintaining speed in rough weather is not so satisfactory owing to the moderate freeboard at the bow. The turret armour gives permanent protection to the breeches of the 67-ton guns and to a certain portion of their length; there is continuous exposure outside the turrets of about two-thirds the length of the guns. In the barbette ships the operations of loading are performed under cover of armour, and the protection is in no way inferior to that provided by the turret. When the guns have been loaded and the breech closed they are raised, and their full length is exposed. The sighting and working of the guns is, however, done under protection equal to that afforded by the turret.

At the time of the design the most important foreign battleships were armed on the barbette system, and the type of barbette adopted in the *Royal Sovereign* was immensely superior to that which was adopted in foreign ships. Hydraulic power was used for mounting and working the heavy guns. The slides on which these guns were carried were pivotted at the front end, and great force was required for the operations of lifting the slides and the guns, but there was no difficulty whatever in handling them. In later practice, it has been found preferable to revert to the "trunnion" system, by means of which guns can be elevated or depressed by manual power alone; and this fact has led to the general adoption of armoured shields carried by revolving turn tables, on which the guns are mounted. These shields give permanent protection to the guns for about one-third of their length from the breech, but leave two-thirds of the length unprotected.

In the *Royal Sovereign* class the principle was first adopted of constructing a considerable number of vessels of a particular type, and so constituting a squadron of homogeneous character. Previously it had been usual to build only one or two ships of similar character, and to vary successive designs. As a result, our battleship squadrons included dissimilar types, armed on different systems, and incapable of acting together with efficiency equal to that realised when sister ships are associated, and are practically identical in the disposition of their armament, speeds, and manœuvring qualities. The advantages attaching to this homogeneity are now universally recognised, and by no writers more fully than by the French. It is no exaggeration to say that all British battleships, built from 1889 to 1902, are capable of working together in squadrons. At present, in the Atlantic Fleet, the latest completed battleships of the *King Edward VII.* class are manœuvring and working with vessels of the *Majestic* class, while the Channel Fleet includes ships of the *Royal Sovereign*, *Majestic*, *Duncan* and *Canopus* classes, equally capable of joint action. As the Japanese have adopted our models in all essentials in most of their modern battleships, their squadrons are equally well fitted to work with ours, and this fact is of great importance in view of the existing alliance between the two countries.

THE TRADE OF THE UNITED KINGDOM.

The annual statement of the trade of the United Kingdom with foreign countries and British Possessions has just been issued. It covers the five years 1900-5. The growth is great, and so far as imports are concerned the increase from British Possessions as compared with those from foreign countries is satisfactory. In 1901 the value of the imports from the other parts of the Empire was £105,684,880, as against £127,868,726 in 1905, an increase of nearly 21 per cent., whereas the imports from foreign countries increased from £416,305,318 to £437,151,191, an increase of only five per cent. But of the £22,183,846 in the imports from other parts of the Empire, India contributes no less than £8,676,557, Canada coming next with £5,841,313. New Zealand, tiny as is its population compared with other parts of the Empire, has increased its exports to the mother country by £2,796,635, whilst Australia shows an improvement of £2,751,308 only. The increase in the imports from India is largely under the head of corn, the value of which grew from £1,035,440 in 1901 to £7,882 978 in 1905, while wool improved from £634,489 to £1,127,116, and raw cotton from £674,194 to £986,224. Jute, too, improved from £4,292,011 to £5,668,961. The Canadian imports show greatest increase in living animals, from £1,439,546 to £2,485,136; cheese, from £3,697,660 to £4,804,172; apples, £305,953 to £703,650; lard, from £237,085 to £628,862; leather, from £153,558 to £378,278; bacon, from £921,509 to £2,751,714; hams, from £304,822 to £698,463. The corn imports show little change, and it is noticeable that the imports of Canadian wood, hewn, of all sorts, fell from £4,029,223 to £3,267,511. The largest part of the New Zealand increase is accounted for by the growth of the imports of wool from a value of £3,877,856 to £5,642 484, but considerable increases are also shown in the value of the imports of butter, gum, hemp—the last-named from £161,489 to £655,275. The imports of fresh mutton increased from £2,949,441 to £3,164,712, whilst the value of the imports of dead rabbits fell from £175,353 to £82,496.

The most striking feature in the imports from foreign countries is the decrease in those from the United States, as from £141,015,465 in 1901 to £115,573,051 in 1905, and this notwithstanding that the value of the raw cotton import in 1905 was £38,314,379, as against £32,355,712 in 1901. The main shrinkage is, of course, to be found under the head of corn and grain, but all sorts of foodstuffs show diminution as indicated by the following figures, which give the value of the imports for 1901 and 1905:—

	1901.		1905.
	£		£
Wheat	13,475,541	..	2,453,527
Wheatmeal and flour	8,698,249	..	2,896,317
Eggs	125,643	..	4,935
Lard	3,775,638	..	3,030,837
Beef (fresh)	6,761,587	..	4,834,611
Bacon	9,255,851	..	5,828,392
Hams	4,209,816	..	2,409,993
Butter	689,164	..	401,916
	£46,991,489	..	£21,860,528

A decrease of no less than £25,130,961. At this rate the United States will soon become an inconsiderable factor in the food supply of the United Kingdom, a matter of great moment from more points of view than one. Whilst our total import trade with the United States has fallen over 20 per cent., our trade with the Argentine Republic has more than doubled, as from £12,414,185 in 1901 to £25,034,325 in 1905. Here again the variations in the corn and grain trade go far to account for the change. The Argentine Republic is rapidly taking the place of the United States as our granary. The value of the wheat imported from the Argentine in 1901 was £2,670,355, in 1905 £8,282,388. In this quinquennial period our imports of wheat from the United States fell close upon £11,000,000, from the Argentine they rose over £5,500,000. So with maize, which rose from £2,616,524 to £5,090,862; fresh beef from £1,218,246 to £3,751,780; and fresh mutton from £1,950,599 to £2,458,915. Our imports from Russia, notwithstanding war and internal dissensions, rose in the five years from £21,903,573 to £33,366,234, this increase again being largely due to corn and grain. The value of the wheat imported from the southern ports alone, rose from £493,960 in 1901, to £8,439,107 in 1905, whilst the import of butter from the northern ports rose from £1,655,288 to £2,246,503. Our imports from Germany show an improvement of about three millions and a-half, and from France, of something under two millions.

Turning to exports, it will be found that our trade with foreign countries has increased much more rapidly than with the rest of the Empire. In 1901, our export trade with foreign countries was valued at £175,148,555, in 1905 it had risen to £216,378,803, an increase of nearly 24 per cent., but the increase in the value of our exports to British Possessions increased only as from £104,873,821 to £113,437,811, or say £8,563,990, a trifle over 8 per cent. And of this increase of £8,563,990, £8,018,262 must go to the credit of India, so that outside India the aggregate of our trade with the rest of the Empire has been practically stationary during the last five years, With Australia, there is indeed very serious shrinkage. as from £21,356,491 in 1901, to £16,991,009 in 1905, a decrease of over 20 per cent. The falling off is general. Even cottons, taking the value, have fallen from £804,927 to £772,668. Glass manufactures, haberdashery and millinery, hardware, hats of all sorts, implements and tools, leather (wrought and unwrought), linens, machinery of all sorts, iron (wrought and unwrought), plate and plated wares, woollens and worsted all show shrinkage. Even the number of parcels sent has dwindled from 71,924 in 1901, to 71,588 in 1905, or taking value from £412,487 to £240,520. It is different with New Zealand, our export trade in the five years with that colony having grown from £5,599,272 to £6,425,793, or not far short of 20 per cent. With Canada our export trade shows satisfactory increase from £7,785,472 in 1901, to £11,909,244 in 1905, cottons, haberdashery, hats, leather, linens, machinery and mill work, iron (wrought and unwrought), woollens and worsteds, ships and boats, all showing gratifying increases. In pleasant contrast to Australian experience, the Parcels Post shows an increase in the number of parcels sent of from 67,013 to 183,144, and in the value from £88,885 to £188,394. The increase in our export trade with India is also very general. Cotton yarn, machinery, iron wrought and unwrought, all show satisfactory increases, and it is pleasant to note that the value of the books sent out increased in the five years from £152,203 to £201,850. In India, too, the Parcels Post seems to be growing in favour, the number of the parcels having increased from 116,512 in 1901 to 208,984 in 1905. The value of our exports to the Cape Colony fell from £11,691,603 to £10,517,188, the fall being pretty general, including cottons, woollens, saddlery and harness, haberdashery and millinery, confectionery and tobacco. The Parcels Post grows in favour, the number of parcels having increased from 185,613 in 1901 to 332,563 in 1905.

To summarise. In 1901 we imported from foreign countries commodities valued at £416,305,318, and exported to them British goods valued at £175,148,555, so that our trade with these countries amounted in 1901 to £591,453,873; in 1905 we imported from them £437,151,191, and exported to them British goods valued at £216,378,803, our trade with these countries amounting in that year to £653,529,994, an increase of £62,076,121 in the five years. In 1901 we imported from other parts of the empire £105,684,880, and exported to them £104,873,821, our total trade with them amounting to £210,558,701, imports and exports being nearly even. In 1905 we imported from them £127,868,726,

and exported to them £113,437,811, our total trade with them amounting to £241,306,537, an increase of £30,747,836, of which imports represent £22,183,846.

MEXICO.

It is a little surprising that Mexico attracts so few emigrants from Europe. Rich in possibilities of many kinds, it does not seem to appeal to any nationality from the point of view of permanent settlement. The country swarms with citizens of the United States, but they are principally engaged in railway road work, banking and mercantile business, mining and prospecting for minerals. They as little think of becoming citizens of Mexico as the English in India dream of remaining there after they have qualified for pension, or made what they consider sufficient money in mercantile pursuits. The total emigration to Mexico in 1905 was roughly 6,000; roughly, because no exact idea can be formed of the numbers crossing the extended northern frontier of the Republic. The majority of the 6,000 come from Spain. Spanish immigrants rapidly assimilate to the native population, owing to the identity of the language, and most of them definitely settle in Mexico, though a certain proportion eventually return to Spain in possession of a competency. They congregate in the towns where certain trades, notably that in groceries, are largely in their hands. A considerable proportion of the emigrants not Spanish are Chinese, who, too, are mostly to be found in the towns where they are engaged in laundry work, or become the proprietors, or cooks or waiters in cheap restaurants. They are frugal and laborious, but they seldom make Mexico their permanent home.

Mr. Max Müller's report on the trade of Mexico (3640, Annual Series) affords abundant proof of the continued prosperity and expansion of the country. Taking the gold value as a basis—and it is in gold that foreign countries buy—there was an increase last year in the exports as compared with 1904-5 of over 10,000,000 dols., but the value of the exports to the United Kingdom fell from 24,991,466 dols. to 16,719,892 dols. On the other hand, the exports to Germany increased from 10,900,415 dols. to 15,719,885 dols. Two years ago the United Kingdom had 12½ per cent. of the export trade, and Germany only 5½ per cent., whereas last year they were nearly equal. The explanation is to be found in the decrease in the exportation of silver. In 1903-4 Mexico exported to the United Kingdom silver to the value of 13,612,942 dols., while in 1904-5 the silver exported to the United Kingdom amounted only to 3,911,988 dols., a decrease of nearly 10,000,000 dols. There is also a slight decrease in the value of the dye and cabinet woods exported, but, on the other hand, the exports of sugar to the United Kingdom have increased about 1,800,000 dols. The import trade of Mexico increased in the years under comparison by about 8,000,000 dols., but the portion of it given to the United Kingdom was a trifle less in 1904-5 than in 1903-4, being 12·11 per cent. as against 12·79 per cent. The decrease in the imports from Germany was much the same, falling from 12·19 to 11·42. The bulk of the import trade was, of course, with the United States, which took 54·43 per cent. of it in 1903-4, and 56·24 in the following year.

The development in the copper-producing districts of Mexico is very remarkable. In 1901 there were 478 copper properties, which produced copper to the value of 11,177,755 dols.; in 1904-5 the number of properties had increased to 808 and the value to 29,803,421 dols. The exports are chiefly in the form of refined copper, the value of the ore being small in comparison, on the average about one-sixth. The exports of lead show some increase comparing 1903-4 with 1904-5. The only other considerable mineral product is antimony, the exports of which were valued in 1903-4 at 1,038,291 dols., but in 1904-5 at only 786,230 dols.

The exports of coffee during the past two years show an increase of about 8 per cent., but the value of the fine and dye woods exported was less last year than in the year preceding. The great demand in the markets of the United States and Germany for a good leaf for the preparation of cigars has induced planters in the district of Vera Cruz, and especially in Tuxtlas, to produce a leaf of the quality desired, with the result that the value of the tobacco exported has risen from 1,899,624 dols. in 1903-4 to 2,725,362 dols. in 1904-5.

Although the drainage system of the Republic is very primitive, epidemics of a serious kind, such as plague and cholera, are practically unknown. Even when such diseases are brought in from foreign countries the measures taken, Mr. Muller says, seem effectually to prevent their spread. But the death-rate in Mexico is very high. While in such a reputedly unhealthy city as Madrid it stands at 27·9, in Mexico last year it was 56 per thousand. The greatest mortality does not, however, come from disease directly dependent on the hygienic conditions surrounding the victims, but from diseases attributed to the atmosphere and the sudden climatic changes, and also to insufficient and unwholesome food and drink, and too light clothing. Thus the largest number of deaths is from diarrhœa and enteritis, 5,201, and next from pneumonia, 3,775. The only two contagious diseases at all prevalent are those of smallpox and typhus, and in nearly all cases belong to the lower classes. A striking feature of the returns is the heavy mortality among infants and children under four years of age. The census returns must be accepted with considerable reserve. The Government does its best to get true and direct returns of the population, but natives still retain a vivid recollection of the internal dissensions when bands of soldiers

came down on the villages and carried away by force every male over twelve or fourteen years of age in order to increase the number in their ranks. Consequently, when the officers appointed by the Government to take the census appear in the villages, many of the men hide themseves, thus rendering the returns very incomplete. The census gives the total population of the Republic in 1895 at 12,491,573, and in 1900 at 13,605,919, being respectively 16·2 and 17·7 to the square mile.

UNITED STATES RAILWAY RETURNS.

Mileage.—The route mileage open on June 30th, 1904, according to the latest report of the Interstate Commerce Commission amounted to 210,904 route miles, or an average 26·34 track miles per 10,000 population and 7·26 miles per 100 square miles of territory. The total equivalent track mileage amounts to 297,073 miles, this figure allowing for double, treble, and quadruple tracks, and sidings. The double track mileage increased 1,143 miles during the year, the treble track by 164 miles, yard tracks and sidings increased by 4,932 miles or 8 per cent. This indicates that commercial conditions render it more desirable to promote increased facilities within the areas already covered than to extend lines into territories not yet supplied with railways.

Locomotive Equipment. — The total number of locomotives in service amounted to 46,743 in 1904, as against 43,871 in the preceding year. Their apportionment to different services is as follows:—Passenger, 11,252; freight, 27,029; shunting, 7,610; unclassed, 852. During the period under review the increase in passenger locomotives was 6,82, in freight locomotives 1,585, and shunting locomotives 552. The locomotive equipment per 1,000 miles length of line works out at 53 passenger, 127 freight, and 36 shunting engines. As regards the duties performed, the average number of passengers carried per passenger locomotive was 63,582, and allowing for the element of distance, the passenger miles per passenger locomotive were 1,948,384. The tons carried per freight locomotive were 48,463, or, allowing for distance, 6,456,846 ton miles.

Passenger Vehicles.—The total number of vehicles used for dealing with the passenger traffic numbered 39,752, being an increase of 1,612 over the number in use in 1903. Per 1,000 miles length of line there are 187 passenger coaches, or 56 coaches per 1,000,000 passengers carried.

Freight Vehicles. — The total freight vehicles numbered 1,692,194, or 7,973 per 1,000 miles of line, or 1,292 per 1,000,000 tons of freight carried. An excellent table subdivide these cars under fifteen main headings based on carrying capacity with seven sub-headings for each class according to the duties required of each. A few quotations will serve to show the general scope of the return. Taking refrigerator cars (a by no means numerous class in England), these numbered 22,735, of an average capacity of 27 tons of 2,000 lbs. each. The most numerous class is that of the 30 ton cars, which number 12,377. Taking coal cars (whose English equivalent is the familiar mineral waggon, of low tonnage), there are in the United States 622,568 waggons used for transporting coal. The average capacity of these is 33 tons, a significant weight when it is remembered that the 20-ton class is by no means common in the United Kingdom. The 30-ton coal car is most popular in the States, there being 197,054 of these. The 40-ton car ranks next in popularity, numbering 158,037, while there are 84,063 50-ton cars used for this traffic.

Operating Staff.—Very interesting and precise are the returns concerning the number of *employés*. The total number employed in the United States in railway transportation is 1,296,211 persons, or 611 per 100 miles of line. The numbers of these are divided into eighteen classes, and range from general officers (two per 100 miles) to station agents—*Anglicè*, station masters—(16 per 100 miles), engine drivers and firemen (respectively 25 and 26 per 100 miles), section foremen (18 per 100 miles), other trackmen (136 per 100 miles), to telegraph operators and dispatchers (14 per 100 miles). The total number employed per 100 miles of line shows a marked tendency to increase, the number having increased from 441 to 611 in ten years. The salaries paid *per capita* are also increasing, the respective figures of the daily remuneration in 1894 and 1904, being:—General officers from 9·71 to 11·61 dollars, station agents from 1·75 to 1·93 dollars, engine drivers from 3·61 to 4·01 dollars, stokers from 2·03 to 2·35 dollars, section foremen from 1·71 to 1·78 dollars, and telegraph operators from 1·93 to 2·15 dollars.

Capitalisation.—The par value of the preference and ordinary share capital invested in American railways is 6,339,899,329 dollars, or 30,836 dollars per mile of line. The funded debt, in the shape of ordinary railway bonds, miscellaneous obligations, income bonds and equipment trust obligations amounted to 6,873,225,350 dollars, or an average of 33,429 dollars per mile of line. By way of interest, 175,713,433 dollars was paid on the common stock, 46,227,616 dollars on preference stock, and 297,674,738 dollars on funded debt.

Produce Carried on Freight Trains.—The total freight tonnage carried amounted, during the year ending June 30th, 1904, to 1,176,604,719 tons, an increase of about 11,000,000 tons on the preceding year. The products of agriculture transported included 58,843,969 tons of grain, 17,323,855 tons of flour, 10,306,768 tons of hay, and 18,832,436 tons of fruit and vegetables. The most prominent item under the heading "products of animals" is live stock weighing 17,968,122 tons; other important freights are dressed meats, 5,004,087 tons, and "other packing-house products," 6,052,281 tons. The weight of wool was 907,062 tons, and of hides and leather 2,348,336 tons. The mineral and allied

traffic were very heavy, the chief items being anthracite coal, 91,391,018 tons; bituminous coal, 303,745,912 tons; coke, 47,879,799 tons; ores, 71,137,107 tons; stone, sand, and kindred articles, 60,663,704 tons. The chief item of note under forest products is lumber, 117,295,124 tons. Manufactured articles are classed under thirteen headings. The chief in point of weight are — petroleum and other oils, 10,868,521 tons; iron (pig and bloom), 28,047,575 tons; iron and steel rails, 8,703,904 tons; other castings and machinery, 19,851,837 tons; bar and steel metal, 20,258,936 tons; cement, buck and lime, 33,053,694 tons.

Loading of Freight Cars.—A very important matter in the economic administration of any railway system is that of limiting the mileage of unloaded freight cars. During the year ending June 30th, 1904, the total mileage of loaded freight cars amounted to 9,849,576,535 miles, and of empty freight cars to 4,501,804,975 miles. That is to say, that out of the total car mileage, nearly 32 per cent. is directly non-revenue producing, and represents a large loss of tractive power. Such losses are inevitable, the best example, perhaps, being those of mineral waggons which take a full load outward from the colliery, returning empty. The carrying efficiency of such cars would be about 50 per cent. Even excluding empty cars, those returned as loaded cannot always be worked to their full capacity. The average capacity per car throughout the United States is 33 tons. The average weight carried of the non-empty cars is 17·7 tons, or allowing for the empty mileage, the average weight carried per average car is only 12·15 tons.

RUSSIAN PEASANTRY AND LAND.

In his report on the consular district of Odessa (No. 3653, Annual Series), Mr. Consul-General Smith gives some interesting particulars bearing upon the Russian agrarian question. In most districts, he says, the peasantry erroneously believe the Czar to have decreed that the land belongs to them, and they maintain that those who work the land ought to be its owners. The area of arable land in the 47 governments of European Russia, omitting Archangel, Wologda, and Olonetz governments as being unsuitable for farming, is estimated as being 791,408,750 acres, of which 228,019,000 acres belong to private owners, and 435,649,500 acres to peasants. The peasants are thus in possession of 55 per cent. as against 29 per cent. held by private persons. In Poland there are 31,064,000 acres, of which 14,962,750 acres belong to private owners, and 13,835,250 acres to peasants, so that the peasantry hold 44½ per cent. as against 48 per cent. held by private owners. In the governments comprising "Little Russia," namely Kieff, Poltava, Podolia, Chernigof, and Kharkof, with an area of 58,377,000 acres, 22,706,750 acres belong to private owners, and 32,840,500 acres to the peasantry, thus showing 56 per cent. in the possession of the peasantry as against 39 per cent. held by private owners. The average is 2¾ acres to each soul of the peasant population. In the southern governments, viz., Bessarabia, Taurida, Ekaterinoslaw, and Cherson, with an area of 52,288,500 acres, 23,270,500 acres belong to private owners, and 29,174,750 acres to the peasants, again showing 56 per cent. held by the peasants and 39 per cent. by private owners. The average is 5·48 acres to each soul of the peasant population.

The figures quoted show that in those governments where the peasants have risen in revolt they already own more than one-half of the arable land. Apparently it is not the want of land which keeps the malcontents from making both ends meet, but the want of knowledge and energy to cultivate and get the most out of the land they already possess. Mr. Smith says that the harvest of the peasantry is never more than one-third, or one-fourth, of the harvest reaped by large tenant farmers, or proprietors, with sufficient capital to work the land. The State Peasants' Land Bank provides the means to enable the peasantry to acquire more land upon easy terms, and the little capital possessed by the peasant goes to meet the first or purchasing instalment. He is thus left without working capital to buy proper implements, or sufficient stock to work the land in a rational and remunerative manner. The land is "hungered," and the peasant can only see relief in the possession of the better worked land belonging to the landowners who, with sufficient capital, work, more or less, upon scientific lines. The total population of Russia when the Census was taken, was 125,640,000, of which 96,897,000 belong to the peasant class. The "privileged" classes represented 2½ per cent. of the total, those able to read and write 21·1 per cent. of the total, thus leaving 78·9 per cent. under the designation of totally ignorant.

CANADIAN FISHERIES.

According to a recent report from Canada, the fishermen on the Detroit River and Lake St. Clair have been complaining of the scarcity of fish, and state that they are not doing sufficient business to pay expenses. The scarcity of whitefish and perch is felt more than any other kinds. A few years ago this class of fish was found in abundance in the Detroit River. To-day these fish are much in demand, and the fishermen are unable to supply their customers. Fishermen claim that the supply of 25,000,000 fry of whitefish sent out by the Sandwich hatchery to replenish the Great Lakes, is not nearly sufficient to meet the depletion of this variety of fish, by reason of fishing, and the destruction by other fish in the large waters and rivers. Millions of mullets, suckers, carp, and other varieties, feed upon the whitefish fry, and it is estimated that only one whitefish minnow out of a thousand reaches maturity. Another factor in this lack of fish is thought to

be the dredging work carried on at Amherstburg. The hatchery at Sandwich has a capacity for handling over a hundred million whitefish fry, but they cannot secure the whitefish during the spawning season to extract the eggs. The whitefish is fast disappearing and will soon be as rare as the buffalo on *terra firma.* A Windsor fisherman recently said, "The Department expends for the propagation and protection of inland fisheries in Ontario, Quebec, Manitoba, and the provinces in the North-West, only £10,000 a year for all purposes, while the sum of £110,000 is expended for the advantage of fishermen in the maritime provimces." Fishermen have observed, especially near French River, how the whitefish deposit their eggs. The water on the shoals is very shallow. The rocky beds would be literally covered with spawn, when suddenly schools of soft fish would appear and the eggs disappear, only a fraction being left in the crevices of the rock. This war of extermination is aided by fishermen pursuing the whitefish. Thus between the devastation wrought by the soft fish and man, whitefish are rapidly disappearing. In Lake Erie, where 2,000 pound nets are in use, the greedy soft fish have been taken from the lake in large quantities and the whitefish decrease is small, although perceptible. The plan offering a bounty for catching the destroyers, and at the same time appropriating a little more money for the propagation of whitefish fry, meets with the hearty approval of all fishermen along the Detroit River and Lake St. Clair.

THE PRODUCTION OF SHERRY.

The vintage of sherry occurs between the 15th September and the end of October. After the grapes are cut, they are left in the sun for two or three days, being covered at night to protect them from the dew. All bad and unripe grapes are separated from the bunches, after which the good grapes are thrown into large, square wooden troughs, when men, bare legged and wearing heavy shoes with projecting iron nails, trample on the grapes, and the juice runs into an adjoining vat. The residue of stems, pips, and skins is put into another trough, and after adding water, these are crushed with a wooden press. The pulp is used for manure and for cattle food. The liquid obtained, called "must," runs into another receptacle, and is of an inferior quality. When the barrels are filled they are put in the cellars, each barrel having a tin funnel inserted in the bunghoie to permit the circulation of air. According to the American Commercial Agent at Jerez de la Frontera, these barrels must have a space of at least four gallons to allow the wine to ferment without overflowing. After the fermenting period of about two months the clear liquid is transferred to other barrels carefully, so as not to disturb the sediment at the bottom. The barrels for the ultimate reception of the wine must be of white oak, perfectly clean, and smoked with sulphur to prevent dampness. The barrels are then stored and carefully classified by experts, and a name given to the wine in the different barrels. It always happens that different kinds of wines are obtained from the same grapes, grown in the same vineyard, and subject to the same treatment. From the same grapes come the mellow (hechos), light (finos), and bouquet (oloroso). Some of the wines are so bad that they are sold as vinegar or used for alcohol. Alcohol of 95 degrees must be mixed with wine at the rate of twelve pints to the butt of eighty-five gallons for each degree of strength desired. To properly preserve wine it should have an alcoholic strength of at least 16 degrees, and as pure wine does not possess that it must be strengthened. The exports of sherry from Jerez to all parts of the world during the year 1904 were 3,269,376 gallons, and for the preceding year, 3,842,424 gallons. Of these quantities, 1,245,348 gallons went in 1903 to the United Kingdom, and 1,255,600 gallons in 1904.

SPANISH CANNING INDUSTRY.

The depreciated value of Spanish currency appears to have aided the Spanish canning industry, which has steadily developed aud prospered during recent years. By the fall in the value of Spanish silver the cost of production was proportionately reduced, thus enabling Spanish canned goods to be offered to foreign markets at such low prices that, in spite of their quality being inferior, it was found possible to open up many new markets. Encouraged by their success, Spanish manufacturers next turned their efforts towards improving the quality of their goods, so that not only have they greatly increased their sales, but the standard of quality has been raised. According to the American Consul-General at Barcelona, the canning factories now working in Spain number 268, of which 147 are exclusively devoted to sardines, and the remaining 121 to fruits and vegetables. The sardine industry is centred on the north-west coast of Spain, in the neighbourhood of Vigo. Fruit and vegetables are canned in the Island of Majorca, and also at Logrono, in the Rioja district. Official statistics show that the exports of sardines in tins during 1905 were valued at about £1,400,000, though leading members of the trade maintain that the correct figures fall little short of £2,400,000. The importance of the industry may be gauged by the fact that a sum of about £400,000 is annually spent on the purchase of fruit and vegetables, £560,000 on sardines, £600,000 on oil, £600,000 in wages, and £720,000 on tin plates and tin. It will be noticed what a large proportion of the cost of production is set down to tin. The production of tin in Spain is not sufficient to supply the demand of the manufacturers of canned foodstuffs, but a drawback is allowed on tin plates when re-exported in the form of packing for canned foods.

HOME INDUSTRIES.

Irish Coalfields.—The absence of native coal in most districts of Ireland has checked the formation of industrial centres in the island, and even the metallic ores, raised from time to time, have been sent for smelting to Ayrshire or South Wales. There are some twenty-four mines at work in the various Irish coalfields, but they employ between them less than a thousand hands. Professor Hull's estimate in 1881 of the "net tonnage available for use" in the Irish coalfields, gave 182,280,000 tons of coal. About 125,000 tons are now raised annually, a little more than at the time of Professor Hull's estimate. The output of Scotland with her rich coal basins between Ayr and the Firth of Forth, exceeds 30,000,000 tons per annum, and has been doubled in five and twenty years. The discovery of extensive and rich coalfields would be a great thing for Ireland, and it is now claimed that such coalfields have been located at Ballycastle, in the north of Antrim. A company has been carrying out preliminary operations for nearly two years, and is about to be registered with a capital of half a million. There will be no public issue, and as its promoters are risking their own money, and not asking the public to find it, it may be taken that they believe, as they say, that they have struck a rich field of coal and ironstone. Their concession covers 10,000 acres, and extensive borings are said to show that there are three seams of coal, and two of black band ironstone. The first two seams of coal are said to be each 3 ft. thick, and both to be first-rate house coals, while the main seam coal, which is from 4 ft. 6 in. to 5 ft., is alleged to be a fine steam coal. The colliery is being provided with the latest equipment, and the management say they anticipate that before the end of the year there will be an output of 1,000 tons of coals daily. Steps, too, are being taken for the erection of furnaces for smelting the ironstone. If the estimate of 60,000,000 tons of coal in the concession, and 150,000 tons of ironstone is anywhere near the mark, it should be a great thing for the district. Ireland imports four million tons of coal each year, and Belfast about a million and a quarter tons of coal annually. If the Ballycastle coal should be equal in quality and price to the coal from Great Britain, it will naturally oust it. It is of course much too soon to assume anything of the kind. It is no new thing to be told of rich coal discoveries in Ireland, but hitherto they have not come to much. It may be the same again, but it is permissible to hope that there are better grounds for present confidence. At least, the progress of the Antrim venture will be watched with interest.

Spinner and Planter.—Reference was made in these Notes some months ago to the Commission then about to visit the Southern States of America to consider the relation between the spinner and the cotton planter. Mr. Macalister, who was the chairman of the Commission, speaking at the International Cotton Congress recently sitting at Bremen, made astonishing statements as to what the Commission found. A new light has been thrown upon the vexed question of damp in cotton. The Commission found that cotton is often artificially moistened, and allowed to lie about uncovered in rainy weather. Again, the cotton is badly bailed, so badly as to add enormously to the cost of transit. Mr. Macalister showed the Congress that whereas the cost of the carriage of well packed Egyptian cotton from Alexandria to Liverpool is at the rate of 18c. per 100 lbs., the cost of the carriage of "a bulky, loose, and ill-packed American bale" is at the rate of 30c. per 100 lb." Mr. Macalister contends that with better packing the cost of the carriage of American cotton could easily be reduced by 5c. per 100 lb., and there would thus be a saving of £375,000 a year. Other savings brought about by the removal of excessive tare, and other things, would easily raise the amount of the saving to £1,000,000 a year. It is to be noted that Mr. MacColl, the chairman of the New England Cotton Spinners and Manufacturers, who was the only American delegate present at the Congress, confirmed Mr. Macalister's statements. A great deal, Mr. Macalister thinks, might be accomplished by getting into closer touch with the American growers and planters. They are full of a new and progressive spirit, he said, and ready and willing to co-operate with spinners in a way of which at present Europeans do not dream. There was general agreement at the Congress that the international organisation would do most useful work if it encouraged to the full extent of its power first the planter to pick the cotton in the most efficient manner and to transmit it on the most economical terms, and second the authorities of the cotton exchanges to modify those of the rules which press harshly on spinners.

Engineering Firms and the Motor Business.—It is not surprising that there is a very general tendency at the present time on the part of engineering firms who have the necessary facilities to interest themselves in the motor business. It is already an immense industry, and no limits can be put to its expansion in the near future. Messrs. Armstrong, Whitworth, and Co.'s connection with the trade is now of long standing, but it was not until the recent Scottish trials of "reliability" that they publicly displayed a car bearing their own name. This car embodies various special features; the engine lubrication has been specially studied, and is arranged so that every bearing is lubricated by a pump forcing the oil at a pressure of about 6 lb., thus ensuring a constant flow, and consequent certainty of sufficient lubrication without the danger of over-lubrication. Messrs. Vickers, Sons, and Maxim's proprietorship of the Wolseley Company is known. Then Messrs. Greenwood and Batley construct electromobile *châssis*, and undertake other motor work. Several firms are manufacturing motor omnibus *châssis*, some under licence from foreign makers, and others com-

mencing under new designs. Then the Westinghouse Company (whose agency has recently been taken up by Friswell, Limited) make powerful modern cars. These and other cases that might be cited illustrate the development of what is expected to be one of the most important branches of engineering.

The Iron and Steel Trade.—Two facts become prominent in examination of the state of the iron and steel trade, namely its extraordinary expansion in recent years, and the comparatively small advance in prices as compared with previous periods of improvement. As to growth, the production of the pig-iron of the world amounted in 1870 roundly to 12,500,000 tons; in 1880 it had grown to 18,500,000; in the next ten years the increase was identical, reaching in 1890 24,500,000 tons; in the decade ended 1900 the expansion was much more rapid, being in that year 40,000,000 tons. Four years later it had reached 45,000,000 tons, and for 1906 it is estimated at no less than 55,000,000 tons. The greater part of this increase is due to the development of the United States. In 1895 their production was only 8,500,000 tons; in 1903 it had increased to over 18,000,000 tons; this year it is expected to exceed 24,000,000 tons. Although the expansion in Germany has been very much less it has been considerable. In 1902 the production of pig-iron there was 8,402,660 tons; this year it is expected to be about 12,000,000 tons. With us there has also been expansion but at a slower rate. In 1901 the production of the United Kingdom was a little under 8,000,000; this year it is expected to be about 10,000,000 tons. It must, however, be remembered that we are now importing iron and steel in half manufactured forms to the extent of over 1,000,000 tons, which must be added to the above figures when estimating our total trade. But, as the *Economist* points out, the weak point at present is in connection with the production of steel. "Whilst other countries," says the *Economist*, "are making steel by the basic process from their native ores, we are depending to a very large extent on imports of ore from Spain and the north of Europe. Last year these imports were the largest on record, amounting to 7,350,714 tons, and this, together with the small output of hematite ores in Cumberland and Lancashire, forms the basis of the 3,500,000 tons of hematite pig-iron produced in this country last year. In the United States no less than 8,000,000 tons of steel are produced annually by the open-hearth basic process, and in Germany about 6,000,000 tons; whilst in this country this process (which was an English invention) has not been used to any large extent—the last returns being about 700,000 tons." It is in this direction we must look for more expansion at home, especially as steel is fast superseding iron in all departments of the trade.

Scotch Shipbuilding.—The first six months of the present year constitute a record in the history of Scotch shipbuilding. During the six months ended June 30, 207 vessels of 360,489 tons were launched, the Clyde contributing 149 vessels and 336,258 tons. In no previous half year has the tonnage put into the water come within 100,000 tons of this quantity. Improved methods of building have greatly quickened construction. By the aid of machinery the heaviest of plates and of sections can now be handled with ease and celerity, and the hull of a steamer can be put together in almost as many weeks as it used to take months. Then the aggregate of the past six months was swollen by the tonnage of the *Lusitania* and H.M.S. *Agamemnon*, but even if these two ships are excluded, the addition to the mercantile marine in the six months is a record. Nor is there any fear that there will be slackness in the second half of the year upon the Clyde. Trustworthy estimates put the tonnage on the stocks and in hand at 384,000, which ensures plenty of work for the rest of the year. If, as is probable, the large shipping companies come forward with their orders the outlook will be assured for a much longer period. Moreover it is considered certain that some of the contracts for war vessels for South American States will go to the Clyde, and should things settle down in Russia it is confidently expected that some of the orders for warships for that country will go to Scotch firms.

Aluminium. — Since 1889 the production of aluminium has increased largely. In that year the total output was only 85 tons, in 1905 it was roughly 8,000 tons. As the production has increased the price has fallen. From 10s. 6d. per pound it has dwindled to 1s. 3d., and if a cheaper raw material than refined alumina could be used further reduction in price would be possible. There are at the present time nine works operating either the Hall or the Héroult methods of aluminium production, and between 40,000 and 50,000 horse-power are employed in the industry. Of these works only one is in the United Kingdom. Three are in America, two in France, one each in Germany, Switzerland, and Austria. A works is in course of erection in the Valley of Pescara, Italy. The demand for the metal is growing in connection with motor car and railway carriage work, the latest example of its use being for the inside of cars for one of the London underground tube lines. The cheaper brands are now being employed in the casting of iron and steel. An invention has recently been patented in the United States for refining aluminium by electrolysis. This depends upon the use of an impure alloy of the light metal as anode, in a bath of molten cryolite, containing alumina in solution, while pure aluminium forms the cathode. All the materials in this bath are kept in the molten state, and the three components are maintained in their respective positions by their different specific gravities, the impure alloy being the heaviest and the pure aluminium the lightest of the constituents of the bath. Aluminium

can be parted from iron, silicon, copper, and other impurities by this method, and it may possibly prove of great use in cheapening the production of the metal, since it will enable producers to use bauxite directly in the reducing baths in the place of the much more costly refined alumina. By the present methods of production, using refined alumina in the reducing baths, it is improbable that any great reduction in price can occur, and therefore the advent of new methods of dealing with bauxite to enable it to be used in place of alumina are of considerable importance. The British Aluminium Company, whose works are at Foyers, in Scotland, and the Newhausen Aluminium Company, which controls the production in Germany, Switzerland, and Austria, have been extending their plant, and a considerable increase in the output of the metal is anticipated in the near future. (See Mr. P. B. Ball's report to the Government of the Dominion, under date May 30th, 1906.)

GENERAL NOTES.

Bulgarian Mining Laws.—In the course of his report upon the trade of Bulgaria for last year (No. 3630, Annual Series) Mr. Vice-Consul Toulmin refers to the mining laws of Bulgaria, which are liberal. The area granted to each applicant is, however, limited to 1,250 acres. The Government refuses to grant a concession unless the Commission of Mining Experts appointed by the Ministry of Commerce and Agriculture have, after visiting the land on which a preliminary search has been made, certified that there is every probability of the mine turning out profitable. This precaution is taken to prevent the *permis de récherche* of doubtful properties being sold by unscrupulous persons and money spent on mines that would not pay. Some such system might work with advantage elsewhere, as, for example, in British colonies where rubber trees are plentiful and promoters active. The Mining Department, which is under the Ministry of Commerce and Agriculture, has just issued a geological map of the country Information is readily given to the different districts in which concessions have been granted, and samples of minerals found are on view, at the Ministry. According to competent judges, Bulgaria is rich in minerals, which have been, however, hitherto but little exploited.

Dunkirk Dock Extension.—The work of extending the Freycinet Docks, authorised by the Law of December 24th, 1903, has now been commenced. It comprises the lengthening of the existing dock accommodation by about a mile of quays. This has necessitated the cutting of the fortifications on the western side of the town, which was begun in April last, and as the docks will occupy the site of the maritime goods sidings of the Northern Railway, it is intended to remove the fortifications to about 1½ metres distance, which will then leave space for further docks. The execution of the new line of fortifications, which besides a front of about 4½ miles long, will include two important military works, will take some time, and the War-office has therefore authorised the construction of a provisional drainage canal outside the limits of the present dock extension, inside which canal a defensive parapet is to be erected, in order that the work of extending the docks at the new railway sidings may be carried out without compromising the defence of the town. The cost of lengthening the docks and the temporary fortifications is estimated to be £1,040,000.

American Railroads.—The aggregate railway mileage of the United States is now placed at 217,328 miles, and statistics have been published with the object of showing that in the not distant future the railroads will probably have a mileage of nearly 1,000,000 miles. Many experiments are being made with electric and gasoline motors for suburban trains. A number of electric railways are in operation, with the object of carrying freight on most of them. This should be an advantage to people living near the lines, who will be able to send garden and dairy produce to neighbouring towns. Milwaukee, a distance of 100 miles north, will soon be connected with Chicago by electric railway. This road, we learn from Mr. Consul Finn's report, will have four lines—two for expresses and two for slow trains—and will connect towns with a combined population of 2,500,000, as well as open up the land along the shores of the lake for suburban residences. The number of locomotives and cars ordered during the past five years has increased from 4,340 to 6,265, the passenger cars from 2,879 to 3,209, and the freight cars from 193,439 to 341,315.

British Trade with Russia.—Mr. Consul Wardrop, who reports on the foreign commerce of Russia (No. 3584, Annual Series), does not seem to take the general view that British traders are altogether behind their rivals in enterprise, and adaptability to the Russian market. He says that where good business is to be done British firms seldom fail to secure a fair share of it, and that investigation would show that in those cases where, through an alleged lack of energy on the part of merchants, manufacturers, and consuls, business goes to foreigners, it is not infrequently unsatisfactory. Siberia was greatly enriched by the military traffic during the war in the East, and the closing of the railway for ordinary goods kept a great deal of money in the country. There is now an extraordinary demand for manufactured goods of all kinds, ready-made clothing, vehicles, guns and ammunition. British preserved goods find a ready sale at good prices in the most remote districts. Omsk is becoming a great trading centre. The railway is rapidly destroying the importance of the fairs at Irbit and other places.

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FRIDAY, JULY 20, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The results of the Advanced Examinations (Stage III.) were published on the 7th inst., and copies have been sent to all centres.

The results of the Intermediate Examinations (Stage II.) will be published about the end of July or early in August, and those of the Elementary (Stage I.) towards the end of August or early in September.

TIME TABLE FOR 1907.

	Monday, April 15. (7—10 p.m.)	Tuesday, April 16. (7—10 p.m.)	Wednesday, April 17. (7—10 p.m.)	Thursday, April 18. (7—10 p.m.)	Friday, April 19. (7—10 p.m.)
Advanced Stage.	Book-keeping. English. Economics. Danish and Norwegian.	Arithmetic. Commercial Law. German. Italian. Spanish.	French. Commercial History and Geography. Typewriting (7.30 to 10 p.m.).	Accounting and Banking. Shorthand (7.15 to 10 p.m.).	Portuguese. Précis-writing. Russian. Swedish. Chinese. Japanese. Hindustani.
Intermediate Stage.	Typewriting (7.30 to 10 p.m.). French. Danish and Norwegian. Commercial History and Geography.	Book-keeping. Précis-writing.	English. Economics. Spanish.	Arithmetic. German. Portuguese. Italian. Russian. Chinese. Japanese. Hindustani.	Swedish. Shorthand (7.15 to 10 p.m.).
Elementary Stage.	Handwriting and Correspondence. French.	German. Italian. Typewriting (7.30 to 10 p.m.).	Book-keeping Spanish.	Shorthand (7.15 to 10 p.m.).	Commercial Geography. Arithmetic.
Music.		Harmony.	Rudiments of Music (7 to 9 p.m.).		

The last day for receiving entries is March 12.

The special subject for Commercial History and Geography is :—The United States of America.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

MODERN WARSHIPS.

By Sir William White, K.C.B., F.R.S.

Lecture IV.—Delivered February 19th, 1906.

Five years (1889 to 1894) were occupied in the execution of the Naval Defence Programme. It had been anticipated that after the completion of this special effort it would be possible to revert to normal annual expenditure on new construction. Naval power is, however, dependent upon action taken abroad; and in 1893 a further programme had to be arranged by Lord Spencer and his colleagues to keep pace with France and Russia combined. No special legislation was associated with this programme, nor was disclosure made of its intentions beyond what appeared in the Navy Estimates for each year, although it was larger and involved greater expenditure than the Naval Defence Act. The advantages attaching to this procedure are obvious. If disclosure is made of a programme extending over a definite period, rivals know exactly what they have to meet; by joint arrangement of individual programmes an aggregate result may be attained, therefore, which equals or surpasses what has been done by the Power framing the programme. During the Naval Defence period (1889-92) the building programmes of France and Russia were arranged in the manner described; a long interval elapsed after the vessels of the *Royal Sovereign* class were ordered before other battleships were laid down here, and as a consequence these two countries kept pace with us.

The battleship *Renown* was ordered in 1892-3, but had not been far advanced when the decision was taken to construct nine battleships of the *Majestic* class. These vessels were 10 feet longer, about 1,000 tons greater in displacement than the *Royal Sovereigns*, and practically equal in speed. Their hull protection was arranged differently from that of the *Royal Sovereign*, and advantage was taken of the introduction of "Harveyed" armour with its superior defensive power. Instead of a thick water-line belt, above which the protection to the main-deck amidships was equivalent to five inches of steel, the *Majestic* class were given armour of nine inches uniform thickness extending up to the main deck about 9½ feet above water. The protective deck in the *Royal Sovereign* class was horizontal and situated at the level of the top of the water-line belt; in the *Majestics* it was turned down to meet the lower edge of the armour. The principal armament consisted of four 12-inch guns of modern type mounted in pairs in about the same position and at the same height above water as in the *Royal Sovereign* class. Improvements in artillery and explosives were utilised in the designs of these guns so that their power was much greater in proportion to their weight than that of the 67-ton guns mounted in the *Royal Sovereign*. Substantial improvements were also made in arrangements for working and loading the guns and shield protection was given to them. The secondary armament was increased to 12 6-inch guns, all of which were placed within armoured casemates. The cost of the vessels was increased about 25 per cent. and the squadron formed by the nine vessels was at the time of their construction admittedly the most powerful which the world had yet seen.

This great effort in battleship construction was followed about two years later by the construction of six vessels of the *Canopus* class of 13,000 tons displacement and 18¼ knots speed. These vessels were designed for easy passage through the Suez Canal. They are considerably lighter in draught than the *Majestic* class and have water-tube boilers; whereas the *Majestic* class had cylindrical boilers. The arrangement of protective armour was identical with that of the *Majestic* class and the length of the vessels was the same, but the thickness of the side armour was six inches instead of nine inches, advantage being taken of the Krupp improvements in order to increase defensive power. The armament was practically identical with that of the *Majestic* class. These vessels formed the strength of our China squadron during the recent war in the Far East, and are now attached to the Channel Fleet. Their shallow draught is favourable to employment in the North Sea.

When the Russian Admiralty undertook its special programme of construction in 1898, Lord Goschen, then First Lord of the Admiralty, made a public announcement in the House of Commons of the intention of the British Government to keep pace with anything that might be done abroad, and six ships of the *Duncan* class represent that policy. They are of 14,000 tons displacement, 400 feet in length, attained a maximum speed of over 19 knots, and carry armaments identical in numbers and calibres of guns with those of the

Canopus and *Majestic* classes. Their hull armour is seven inches in thickness and of Krupp quality. Increase in speed involved an increase in power from 12,000 horse-power of the *Majestics*, and 13,000 horse-power of *Canopus* to 18,000 horse-power. Whereas the *Majestic* cost about £984,000, and the *Canopus* £924,000, the *Montague* (also dockyard built) cost over a million sterling.

Another group of eight battleships, known as the *Formidable* class, now constitute a powerful Mediterranean Squadron. They may be shortly described as improved *Majestics*, all the progress made in naval artillery, armour and propelling apparatus subsequent to the design of the *Majestic*, having been utilised in the designs. They are 400 feet long, 15,000 horse-power, and 15,000 tons displacement. Their hull armour is of Krupp quality, and the thickness is equal to that of the *Majestic* class, so that the defensive power is 25 to 30 per cent. greater. The 12-inch guns, although of the same calibre, have 15 to 20 per cent. greater energy. Water-tube boilers are fitted, and with natural draught the ships attain 18 knots as against 16½ knots of the *Majestic* class under the same conditions. These vessels cost about £1,100,000 each. They were followed in 1901 by eight vessels of the *King Edward* class, of which five are on service in the Atlantic fleet, and three are approaching completion. These vessels are 425 feet in length, 16,350 tons displacement, 18,000 horse-power, and can steam 19 knots. Their hull protection is practically equal to that of the *Formidable* class. Their armament includes four 12-inch guns of improved type, mounted in pairs as in the *Formidable* class; four 9·2 inch guns, mounted as bow and stern-chase on the upper deck, with strong armour protection; and ten 6-inch guns mounted in a battery on the main deck. The 9·2 inch guns were introduced because the increase in the protection of secondary armaments in foreign battleships and armoured cruisers made the 6-inch gun of less value than it had been, especially at long ranges. The cost of the *King Edward VII.* is nearly a million and a half sterling, exclusive of armament. The *Lord Nelson* and *Agamemnon* were laid down in 1905. They are 440 feet long, of 16,500 tons, and nearly 17,000 horse-power. The estimated speed is 18 knots. They are to be armed with four 12-inch and ten 9·2 inch guns; eight of the latter are mounted in pairs on the upper deck, and two are mounted singly. The probable date of completion of these vessels is 1908. The *Dreadnought* (also laid down in 1905) is reported to be nearly 500 feet long, 82 feet broad, and more than 18,000 tons displacement. Her estimated cost approximates to a million and three-quarters sterling. She is to carry ten 12-inch guns of the latest pattern, mounted in pairs in five positions. Besides these heavy guns the armament will include a number of 3-inch guns of improved pattern equal in calibre, but superior in power to 3-inch guns carried by previous battleships for defence against torpedo boat attacks. She is to be propelled by steam turbine machinery, the aggregate power being about 23,000 horse-power, and the anticipated speed 21 knots. This is the largest and most costly battleship yet laid down. It will be noted that the expenditure upon her will be more than double that on the *Royal Sovereign* of 1889. The *Warrior* of 1859 cost less than £400,000; the *Minotaur* of 1861 cost £480,000; the *Dreadnought* of 1871 cost about £600,000; the *Inflexible*, completed in 1881, cost £810,000; the *Formidable* class cost about £1,100,000 each. The question naturally arises whether this enormous expenditure on a single vessel will produce commensurate results. Up to a certain point it has been desirable to secure a great concentration of offensive and defensive powers in single ships; but the multiplication of heavy guns in a vessel costing so much as the *Dreadnought* introduces new considerations. Without discussing these it may be said that great difficulties must occur in mounting ten 12-inch guns so as to secure full efficiency for all of them, even in so large a ship as the *Dreadnought*. It is, indeed, worth serious consideration whether advantage would be gained by distributing the expenditure required for two *Dreadnoughts* over three vessels which collectively might have equal speed, armament and defence, and possibly superior fighting force. Increase in numbers, subject to these conditions, would be accompanied by lessened risk of disablement or foundering in case of grounding or under-water attacks by torpedoes or by casual projectiles, which recent experience proves, may penetrate below the side armour. Tactical advantages might also be gained by increase in numbers. These and other questions will have to be faced, but the discussion of them in this place is not possible.

Foreign battleships have usually been of smaller displacement than British battleships

designed and built about the same time. The principal reasons for the larger displacement of British ships were found in their larger supplies of stores and coal, which gave them greater sea-keeping powers. In later years the difference in dimensions has been less marked, foreign naval authorities having recognised the great importance attaching to sea-keeping power and having consequently increased coal supplies and stores. In all navies there has been a very marked advance, and the proportionate increase in size and cost has been greater abroad than in the Royal Navy. For example, the French battleship *Marceau*, dating from 1887, is of 10,600 tons displacement and 14,000 horse-power, with a speed of 16½ knots, and a cost of £770,000. The vessels of the *Patrie* class now building are of 14,600 tons displacement, 18,000 horse-power, to steam 18 knots, and cost over £1,400,000. The battleships to be laid down this year are to be of 18,000 tons displacement, and are to cost approximately two millions sterling. The German battleship *Kaiser Frederick III.*, dating from 1896, was of 11,000 tons displacement, 13,000 horse-power, 18 knots speed and cost £960,000. The vessels of the *Hessen* class, the last completed, are of 13,000 tons displacement, 16,000 horse-power, about 18½ knots speed, and cost £1,200,000. The new German battleships just beginning are to be of 18,000 tons displacement, and the estimated cost is about £1,800,000. The United States battleships of the *Massachusetts* class begun in 1891, are of 10,200 tons displacement, 10,000 horse-power, steam 16¼ knots, and cost, exclusive of armour and armament, £600,000. The *New Hampshire* authorised to be built in 1904, has a displacement of 16,000 tons, 16,500 horse-power, the estimated speed is 19 knots, and the estimated cost, excluding armour and armament, is nearly £900,000; adding the armour this vessel would cost at least as much as our *King Edward* class.

It will be noted from the foregoing figures that the cost of foreign battleships, although of smaller dimensions, is fully as great as the cost of the British battleships of the same date. Very often this cost is expressed at the rate per ton of displacement; that method, however, is fallacious; because the displacement tonnage includes not merely the hull, armour, machinery, accessories and fittings, but also includes the weight of armament, ammunition, consumable stores and coal which are not included in the cost and which in different designs bear very different proportions to the total displacement. The broad facts to be noted is that the construction of warships in this country costs less than that abroad; our resources in shipbuilding, engineering, armour and armament are so much greater than the corresponding resources in any foreign country that the speed at which construction can be carried out is greater than that which can be attained abroad. This fact is the key of the true policy in warship construction for the British Navy. It is always possible for the Admiralty to know exactly what is being done abroad in all classes of ships, to wait until foreign vessels have been laid down, then to complete designs which shall be superior in offensive and defensive power, and to complete the vessels as soon as their possible foreign rivals. This policy has been consistently followed by successive Boards of Admiralty with rare exceptions, and these have only emphasised the soundness of the policy itself. It is absolutely necessary that the Royal Navy should always possess a superior force of battleships ready for service, since upon that class of vessel the final issue of a naval war must depend.

Before passing away from the consideration of battleships, it may be interesting to summarise the principal steps in the improvement of naval guns, gun-mountings, and ammunition. Progress in that direction has been no less remarkable than that made in the manufacture of armour; and the most important advances in both have been effected during the last 16 or 17 years. When the iron-clad reconstruction began, the most powerful naval gun was the 8-inch 68-pounder 95-cwt. cast-iron smooth-bore using spherical cast-iron projectiles which could not pierce 4½ inches of iron at close range. Sir William Armstrong introduced his 110-pounder breech-loading wrought-iron rifled gun, firing "ogival" headed projectiles, about the same time as iron-clads were begun. This gun was 10 feet long and had a much higher muzzle velocity and greater accuracy than the 68-pounder. Owing to accidents which Sir William Armstrong regarded as preventable but which naval officers thought likely to recur in practice, the breech-loading system was abandoned in favour of muzzle-loading rifled guns. The 7-inch 6½-ton muzzle-loading gun was 11 feet long, its projectile weighed 115 lbs., and could penetrate 7¼ inches of iron at 1,000 yards' range. In 1863 9-inch 12-ton guns were introduced, throwing 250 lb. projectiles,

capable of penetrating 10 inches of iron at 1,000 yards' range. Within three years 10-inch 18-ton guns, throwing 400 lb. projectiles, capable of penetrating $11\frac{3}{4}$ inches of iron at the same range, were adopted for the principal armament in the central battery of the *Hercules*. Immediately after 11-inch 25-ton guns, throwing 550 lb. projectiles, capable of penetrating 13 inches of armour, were adopted for the turret ships *Monarch* and *Captain*. The 18 and 25-ton guns were 15 feet in length. Twenty-five-ton guns were also mounted on the broadsides of some iron-clads, but as heavier guns were introduced the turret system prevailed. In 1869 12-inch 35-ton guns were used as the armament of the *Devastation* class; the *Dreadnought* (as re-designed in 1872) was armed with four $12\frac{1}{2}$-inch 38-ton guns, $18\frac{1}{2}$ feet long, firing 820 lb. projectiles, and capable of penetrating $17\frac{3}{4}$ inches of iron at 1,000 yards. The original armament, contemplated for the *Inflexible* in 1873, consisted of muzzle-loading guns weighing about 60 tons. These guns were never made; the armament finally decided upon included four 16-inch 80-ton guns, nearly 27 feet long, firing 1,700 lb. projectiles, capable of piercing 23 inches of iron at 1,000 yards. Armour-piercing projectiles of these muzzle-loading guns were of chilled cast-iron made on the principle introduced by Palliser. The gunpowder used was quick-burning, great pressures were developed in the bores of the guns, and the combustion of the charge was often imperfect.

Before the *Inflexible* was completed, the breech-loading system had been again introduced for British naval guns. Sir Andrew Noble and Sir Frederick Abel having thoroughly investigated the use of slow-burning powders, had demonstrated the advantages of increased lengths in proportion to calibres, and had shown that greater muzzle velocities could thus be obtained with diminished powder pressures. With muzzle-loading guns the maximum velocities attained had been about 1,600 feet per second. With the improved condition this was raised to 2,000 feet per second in 6-inch and 8-inch experimental breech-loading guns. About 1881 the breech-loading system was finally approved for the Royal Navy. Since that date remarkable progress has been made in guns, gun-mountings, and projectiles. Smokeless powders have been invented and greatly improved. The largest breech-loading guns mounted in the *Benbow* and *Sanspareil* are 110 tons in weight, $16\frac{1}{4}$ inches calibre, 47 feet long, throwing 1,800 lb. projectiles, with a muzzle velocity of nearly 2,100 feet, capable of penetrating $34\frac{1}{2}$ inches of iron at 1,000 yards. Next in dimensions come $13\frac{1}{2}$-inch 67-ton guns carried by the *Admiral* class, the *Nile* and *Trafalgar*, and the *Royal Sovereign* class, built between 1881 and 1892. These guns are 36 feet long, the projectiles weigh 1,250 lbs., the muzzle velocity is 2,000 feet per second, and the penetrative power 30 inches of iron at 1,000 yards. When the *Royal Sovereign* class was designed, no satisfactory 12-inch gun was available, or it would have been adopted The earliest 12-inch breech-loading guns were about $27\frac{1}{2}$ feet long, and weighed 45 tons, throwing 714 lb. projectiles with a muzzle velocity of about 1,900 feet per second, and a penetrative power of $21\frac{1}{2}$ inches of iron at 1,000 yards. The 12-inch guns now carried weigh 50 tons, are $41\frac{1}{2}$ feet in total length, have 850 lb. projectiles, a muzzle velocity of 2,600 feet per second, and a penetrative power of 38 inches of iron at 1,000 yards. For the *Dreadnought* (1905) the length of the guns is to be increased by 5 feet, and the muzzle velocity raised to 2,850 feet per second, with a corresponding increase in penetrative power.

Similar progress has been made in breech-loading guns of moderate calibres. The $7\frac{1}{2}$-inch gun, weighing 16 tons, can penetrate about 25 inches of iron at 1,000 yards; whereas the original 8-inch gun weighing 14 tons could only penetrate $15\frac{1}{2}$ inches. The earlier breech-loading 6-inch guns weighed 5 tons and had a penetrative power of $10\frac{3}{4}$ inches of iron at 1,000 yards; whereas the modern 6-inch gun, weighing $7\frac{1}{2}$ tons, can penetrate 18 inches of iron at the same range. Higher muzzle velocities and greater energies are accompanied by greater accuracy of fire, the trajectories are flatter and the "danger spaces" greater, especially at long ranges. Maintenance of energy and penetrative power at long ranges is favoured by greater weights of projectiles. As a consequence heavy guns have a distinct advantage in these respects over lighter guns when the muzzle velocities are equal. Efficiency in long-range firing requires improved optical instruments for sighting and range finding; this want has been met by modern inventions. Long-range fighting has become necessary largely in consequence of improvements made in speed and accuracy of modern locomotive torpedoes. The full effective range of the Whitehead torpedo was formerly about 800 yards and the minimum fighting range was

taken as 3,000 to 4,000 yards. Some authorities consider that with modern 12-inch guns effective practice will be possible at ranges up to 10,000 yards. It must be noted, however, that in actions between the Japanese and Russian fleets much smaller ranges were deliberately adoptod on several occasions and particularly in the battle of the Korean Straits.

Many persons now favour the entire abolition of secondary armaments, such as have been used in battleships and large cruisers during the last 25 years, and recommend the exclusive adoption of 12-inch guns in association with a number of 3-inch guns throwing 15 to 18 lb. projectiles to be used as a defence against torpedo attack. The *Dreadnought*, for example, is to carry ten 12-inch guns and a number of 18-pounders. In popular descriptions of that vessel it has been assumed that because her 12-inch gun armament will equal in number that carried by two or three of the earlier battleships she would be equal in fighting power to such a group of ships. This method of comparison obviously overlooks important factors and cannot be accepted. Heavy guns demand large arcs of training for their effective use in fleet engagements, and even in so large a ship as the *Dreadnought* it is difficult to secure for ten 12-inch guns anything like the same individual efficiency as is possessed by four 12-inch guns mounted in the manner universally accepted for most modern battleships. The adoption of this system of armament has been much discussed abroad as well as in this country, and various decisions have been reached in the designs approved for new battleships in other Navies. In essence the system of the *Dreadnought* now building is identical with that which found favour from 1869 to 1879 in vessels like the former *Dreadnought* or the *Inflexible*. It rests upon the assumptions that actions will be chiefly decided by the power of penetrating defensive armour at long ranges, or on the superior "smashing" effect (that is to say, the greater energy) maintained at long ranges by heavier projectiles. Experience in the war between Russia and Japan does not bear out either of these assumptions. In the battle of the Korean Straits the Japanese ships carried 16 12-inch guns as against 26 carried by the Russian ships, and one 10-inch gun as against 15 in the Russian ships. On the other hand, the Japanese ships carried 110 8-inch and 6-inch guns, and the Russians 48 6-inch and 11 4·7-inch. According to the best accounts of this battle and of the action of August 10th off Port Arthur, the result was not decided by penetration of side armour or of armour protecting the principal guns, but by injuries sustained by navigating stations and steering gear, by access of water to the interior (especially towards the extremities) of ships in consequence of injuries to armoured or lightly armoured portions of the broadside, and by injuries to horizontal deck-armour. All this class of damage was well within the capacity of 6-inch and 8-inch guns, and cannot be ignored. Moreover, in the best defended modern warships there are many weak places and unprotected features where rapid and continuous fire of 6-inch guns may produce serious injury and demoralisation quite apart from perforation of armour or smashing effect. Even if 6-inch guns under modern conditions should be thought wanting in power it by no means follows that uniform armaments of 12-inch guns are a necessity, or that the best utilisation of the total available weight of armament is to be found in uniformity of calibre; having regard to the limitation in the number of rounds per gun carried for the larger calibres and the great weights involved in installing such guns and giving to them adequate protection and arcs of command. The French have acted upon this opinion, and their new battleships are only to carry four 12-inch guns, supplemented by twelve 9·4-inch guns.

The introduction of heavy guns involved dependence on mechanical power and machinery for working and loading; this change has had a marked effect on first cost and outlay on maintenance and repairs. In the *King Edward VII.* class, for example, the cost of gun mountings exceeds £200,000, 90 per cent. of which was expended on the four 12-inch and four 9·2-inch guns. This sum would have sufficed for the construction of a three-decked screw line-of-battle ship, such as was building concurrently with the *Warrior* in 1859, or for two sailing three-deckers of Nelson's time. Mechanical engineering and the employment of power for auxiliary purposes now forms an important part in the internal economy of warships and is in many cases essential. On the other hand, it is necessary to resist the tendency to overdo the application of mechanical power since it involves increased complication, greater first cost, larger outlay on maintenance, and increased risks of breakdown in action. In many cases important mechanical arrangements are either entirely unprotected or imper-

fectly protected and consequently would be damaged and made incapable of operation under gunfire in a very short time. Simplification of details and the adoption of arrangements that will continue workable in action are most desirable, and the fact that large coal consumption is required for these auxiliary services should not be overlooked. When the use of manual power involves serious risks to life it is clearly not desirable; but it possesses a flexibility and power of adaptation to exceptional conditions not attainable with machinery, and ought therefore to be utilised to the fullest extent compatible with efficiency and rapidity of working.

Improvements in the "propellants"—gunpowder, cordite, &c.—used in modern guns have been made continuously, on the lines of securing slow and complete combustion of the charges, and reduction of pressures on the guns. Improvements in explosives, fuses, &c., have been equally sought after, in order to increase destructive effect and to secure safety in firing projectiles by making premature explosion in the gun less likely. Improvements in projectiles have been equally important, both in armour-piercing shot, and in shells. Chrome-steel forged projectiles have been followed by special forms of cast-steel shot and shell

When the armour-plate maker increased resisting power, the manufacturer of projectiles responded by further changes, including the use of "caps," which enabled shot to hold together on impact and to penetrate hard-faced armour instead of being broken up. So the struggle between attack and defence has proceeded incessantly, and is still in progress after fifty years, with no prospect of termination.

FACTORIES AND WORKSHOPS.

As usual, the annual report of the Chief Inspector of Factories and Workshops contains a mass of information as to the industries of the United Kingdom, and the way in which they are carried on. It shows progress in those directions with which the department is particularly concerned, namely, in the removal of abuses connected with labour, and the amelioration of conditions under which factory hands and others work. But it shows, too, that much remains to be done before it can be said that the conditions of labour in factories and workshops leaves little or nothing to be desired. Take the food industries, and that section of them which may be assumed to present the least repulsive aspects where ill-managed, namely jams, confectionery, and the like. Speaking of Ireland, the Inspector says it is surprising to find how little attention is paid to cleanliness in the majority of food-producing places. The bottle-washing rooms in which empty jam pots from which it is desirable to remove the dirt and old labels are washed are not only very unsatisfactory from the point of view of the workers in them, but the usual hot, heavy, atmosphere, loaded with steam, is rendered more oppressive by the disgusting smell arising from the water in the tanks over which the dripping women bend. When the Inspector called "hundreds of dirty pots were being 'washed' in this liquid, which was like dark soup, and smelt abominably." The pots, when fished out, are allowed to stand until they become dry, and are then considered fit to receive the jam. Chocolates and "sweets" are very much handled in the making, and the condition of the hands, and the lack of proper washing conveniences, are matters which would probably be more disturbing to the consumers than they appear to be to the small girls and boys engaged in handling them. In one factory, having noted the condition of the chocolate-makers' hands, the Inspector asked to be shown the washing places, and was conducted to a corner of the boiling room, where a sugar iceing pan with some of the sediment of iceing still in it, was being filled with cold water for washing purposes!

Turning to England, the Inspector says that in spite of the fact that fruit preserving as an industry has increased rapidly of late years, there are not many time-saving appliances in use; the carrying of jam and jam-pots, empty or full, is still done largely by women and girls, it being very usual for a girl of fourteen to be carrying a 40 lb. tray. The Inspector inspected one jam factory where the boiling-room lay between the yard and the stable, and the horses reached the stable through the boiling-room. In others he found the sanitary accommodation very inadequately separated from the rooms where fresh fruit or uncovered jam is kept, and dirty, undrained floors are far too common.

It would hardly be thought that the increase in the size of steamships would lead to serious increase in the number of accidents and loss of life. Yet so it is. As is well known, modern ships are larger, deeper, and heavier than vessels built even a few years ago. At the present time a Cunard liner is being built on the Tyne which measures over 700 feet in length, and on which there are nearly 800 men at work, two electric lifts carrying the hands to the various working levels, and whenever possible electric lights are used inside and out. It will be readily understood that a fall from a ship 50 feet high is much more likely to be serious than from half that height, and to this fact must be attributed the increasing severity of the accidents. Production also appears to be carried on with greater haste, and this is an important factor in dealing with accidents, as the great majority are due to falls from stagings, and when a man is hurried he will naturally take less care when working at a height, or to save time will risk

his life on a single plank. A large number of the accidents is among lads of 14 or 15 years old. These little men, with all the natural indiscretion and inexperience of youth, are set to work on narrow stagings at giddy heights, have to run along narrow planks with hot rivets in all weathers, and scramble up and down hold ladders 30 or 40 feet in length with wide step rungs, where a momentary slip means a crashing fall on to the steel flooring plates below.

Reporting on the Birmingham brass foundries, Miss Power notes that female workers at drilling, &c., machines, are in the habit of taking refreshment in the shop at which they work. The waste from the machines in question consists of particles of brass of various sizes, ranging from visible splinters to dust. Workers coming from a distance, and commencing work at 8 a.m., often, it would seem, after a meagre and hasty breakfast, are accustomed in shops where the dinner hour is deferred until 1 p.m. to partake of refreshment mid-way between these hours. The food which they bring with them mostly consists of bread spread with butter or jam, and it is eaten in the shop during the ten minutes or quarter of an hour interval for luncheon. The circumstances under which such food is consumed afford many facilities for the adherence to it of metallic particles shed by the machines.

Miss Saddler refers to the conditions of labour in West End work-rooms. Many of the complaints received refer to lack of sufficient means of warmth for the work-rooms, the Court dressmakers and the ladies' tailors being among the greatest offenders. Too often the rooms are absolutely unwarmed except for the gas jets used for lighting purposes. In many cases no doubt the difficulty with regard to fires in work-rooms is that they have no coal-cellar or places for storing fuel. They take to start with, perhaps a show room, and one or two work rooms on a first or second floor, and depend entirely upon gas for warming purposes. Although there are now many makers of gas stoves with flues, it is very common to find these badly joined to the stoves, and fumes escape. The basement work-room, and the dark back rooms, are, again, a difficulty, as the unventilated gas jets, which would be illegal for warming purposes, become legal as a necessary means of light, and form the means of warming as well.

The hours worked in London laundries by women and girls seem to be increasing in length, and to be more excessive than ever. Paper-bag making is a trade which is often carried on in the poorest kind of workshop, badly lighted, ventilated, and heated. It is to these conditions, no doubt, that the weak inflamed eyes so often seen among the workers are due, at least partly.

The amount of active work accomplished in official visits and travelling during 1905 by the inspectors and their assistants may be gathered from the following figures :—2,673 factories were visited, and 3,607 workshops. Other visits numbered 2,516, and the miles travelled amounted to 66,828.

BRITISH TRADE WITH CHINA.

In reporting upon the trade of Tientsin (No. 3661, Annual Series), Mr. Consul-General Hopkins makes some observations which are not without point. It has been customary, he says, to make British Consular officers the scapegoats for the failure of British trade to keep pace with its foreign competitors, but he contends that inspection of the archives of any British Consulate in China would show that the fault lies to a great extent not with the Consul, who does what he can, but with the inability or unwillingness of the British merchant at home to adapt himself to new ways, and with his general ignorance of the conditions of trade and life in so distant a country as China. Mr. Hopkins says the letters from merchants in the United Kingdom who apply to consuls to assist them in extending their business in their districts show that the merchants making the application cannot have given the most cursory study to the reports of the consuls from whom they are soliciting assistance. Mr. Hopkins refers to his own experience, taking the letters addressed to the Consulate-General during 1905. Some applications were received from makers of musical instruments who had heard of the proposed institution in China of military bands, and wished their names brought to the notice of the authorities concerned. One application came from a manufacturer of paper mill machinery, who also wished to be brought into touch with the Chinese Government. There were inquiries from a manufacturer of tools, of corks, of goods for electrical purposes, of iron and steel tubing, and of cream, from a supplier of groceries, and a contractor for dredging operations and the supply of dredging machinery, all of whom wished to learn whether there was any opening for them to utilise with a view to expanding their business. These applications were reasonable and justified by statements in various trade reports, and by the requirements of the port. In another class, however, should be placed the merchants and manufacturers who were looking to Tientsin to increase their sales of diving apparatus, sanitary earthenware, brakes for cycles, agricultural implements, pneumatic golf balls, aseptic hospital furniture, or motor vehicles, of which the demand for some does not exist, and for others is very small and supplied by the wholesale importers in Shanghai. One applicant wished to export China wood oil to Canada. A reference to the Customs tables would have shown to him that so far from being exported from Tientsin this article is imported. On the other hand, in 1904 the output from Shanghai was 204,674 cwts., and from Hankow 505,839 cwt. Another writer wished to import ginseng into Tientsin, having gathered vaguely that there was a demand for this article in China. So there is, but not in Tientsin, seeing that in 1904 no more than 445 lbs. were imported, whereas during the same year in Hankow the import was 47,416 lbs., of which 20,545 lbs. were re-exported, and in Shangai the net import was 212,822 lbs. Mr. Consul

Hopkins insists that the only method of pushing British manufactures in China is by means of Chinese-speaking commercial travellers, with numerous samples of their goods and working models of their machinery. One might even take a leaf out of the book of the Viceroy of Chihli, who has already taken practical steps in helping the trade of his district by the establishment of a commercial museum in which are exhibited specimens of every article made in the province, and to each article is attached a ticket giving the address of the maker, the price, &c.

IMMIGRATION AND EMIGRATION.

The statistical returns relating to emigration and immigration from and into the United Kingdom in the year 1905 are now available. They describe in exact detail the movements of population over a series of years. The section dealing with alien immigration from the continent of Europe arrives at conclusions not in accord with popular opinion. The total number of persons entered on the Alien Lists for 1905 was 196,587, as against 194,986 in 1904, and 207,191 in 1903. But of these 108,408 were stated on the lists to be *en route* to other countries. They touched at an English port only to leave it again, usually for the United States. Then there were 13,793 seamen on the lists, of whom very few were prospective settlers. Deducting these two classes, there is a remainder of 74,386, as compared with a similar remainder in 1904 of 82,845, and in 1903 of 69,168. But further deductions have to be made before the net addition to the alien population of the United Kingdom in 1905 is reached. Officers of His Majesty's Customs ascertained that in the course of the year not less than 8,440 aliens were, in fact, *en route* to other countries, although not so entered in the Alien Lists. This makes the number of alien immigrants actually settling in this country 65,946, but, in fact, it is very much smaller. It may be useful to quote the Report on this point. Far more complete figures have been issued under the Aliens Act, 1905, for the first quarter of 1906, and they show that—

"Out of 84,000 alien passengers arriving in this country from ports of Europe and the Mediterranean Sea about 35,000 were cabin passengers, or exempted second-class passengers, leaving, roughly speaking, 49,000 persons of about the same description as would have been included in the Alien Lists under the Act of William IV. if it had still been in force. Of these some 41,000 were either seamen or were known to be proceeding to destinations outside the United Kingdom. If we were to apply these proportions to the total numbers recorded in the Aliens Lists in 1905, we should arrive at a maximum number of about 32,000 instead of 66,000 persons who might have been intending to reside permanently or temporarily in the United Kingdom."

But even these comparatively small figures have to be reduced before the actual net addition to the alien population of the United Kingdom is arrived at, for account has to be taken of emigration that may have taken place subsequently, and of the emigration of aliens who may have arrived in this country in earlier years. That such an outward flow of aliens from this country over and above the direct flow from Europe through the United Kingdom is considerable is indicated by the fact that during 1905 the London Jewish Board of Guardians, and the Conjoint Committee of that body and the Russo-Jewish Committee, assisted some 4,000 persons to emigrate, or to return to the Continent, and it is known that on a smaller scale various Jewish organisations in the provinces are in the practice of assisting foreign Jews to emigrate. It is clear from these facts that there has been much misapprehension as to the extent to which the alien population of the United Kingdom has increased in recent years.

A Table on page 59 contains information with regard to aliens to whom passages to places out of Europe were refused in the United Kingdom in 1903-5 on the ground that they would probably be rejected by the emigration authorities of the countries to which they desired to proceed, and it appears from these returns that passages were refused to 814 aliens in 1903, to 1,721 in 1904, and to 1,913 in 1905. While many of these aliens are stated to have been sent back to the Continent, a large number were sent to places in the United Kingdom, principally to London. Inquiries tend to show that the majority of these people eventually succeeded in reaching their desired destination, sometimes after a preliminary period of waiting in London during which medical treatment was obtained at the hospitals and dispensaries, but frequently without such interval a great majority of these persons were suffering from trachoma.

Among the chief features of interest in the passenger movement of 1905, between this country and countries out of Europe, are the large British emigration to British North America and the large emigration (both British and Foreign) to the United States. The number of persons of both British and Irish origin who left the United Kingdom for the Dominion in 1905 was 82,347, the highest number for any preceding year being 69,681 in 1904. The number of persons of British and Irish nationality who went to the United States in 1905 was 122,370. Of the total number of emigrants from Great Britain and Ireland (262,077), 47 per cent. went to the United States, 31 per cent. to British North America, 6 per cent. to Australia and New Zealand, 10 per cent. to South Africa, and 6 per cent. elsewhere. The percentage going to British North America was never so high as in 1905, and to Australia and New Zealand never so low save in 1903 and 1904 when it was only 5 per cent. Of the total British and Irish emigration, 65 per cent. was English, 16 per cent. Scotch, and 19 per cent. Irish. With the exception of 1902 and 1903 the percentage from England was

never so high as in 1905; the percentage from Scotland was the highest on record, but from Ireland it was the lowest, 1903 excepted, when it was only 18 per cent. Of the 82,347 emigrants from the United Kingdom to British North America 64,876 were English, 14,214 Scotch, and only 3,347 Irish. Of the 122,370 who went to the United States 58,229 were English, 19,785 Scotch, and 44,356 Irish. Out of a total of 15,139 to Australia and New Zealand only 863 were Irish and 1,872 Scotch; of 20,609 to Cape Colony only 958 were Irish and 3,329 Scotch; of 5,698 to Natal only 275 were Irish and 1,158 Scotch.

The relatively low proportion of children among Irish emigrants continues to be a noticeable feature. Of the 170,408 emigrants from England 14·4 per cent. were children; of the 41,510 from Scotland 14·7 per cent. were children; but of the 50,159 from Ireland only 7·9 per cent. were children. And this proportionate percentage has been maintained over a long series of years. Again, whilst there was an excess of 40,591 English male emigrants over females, and 10,411 Scotch, the Irish female emigrants exceeded the males by 134. Here again the contrast is not exceptional seeing that ever since 1893 more women than men have left Ireland, and in 1904 the excess was 4,782. That Irish children emigrants should be fewer than English or Scotch is explained by the fact that emigration from Ireland is largely composed of emigrants between the ages of 15 and 25, the marriage section being small. It would be interesting to have an authoritative explanation of this exceptional female emigration. The percentage of servants to population is higher in Ireland than England, and young women may find it even more difficult to get employment in Ireland than the men. Moreover, emigration, with its marriage possibilities, may seem particularly attractive.

Turning to the occupation of adult male and female emigrants in 1905 of British and Irish nationality, the tables show that 12,101 were of the agricultural classes; 5,843 commercial and professional; 12,304 belonged to skilled trades; 25,605 labourers; and 18,411 miscellaneous or not stated. Of females 5,477 were in domestic or other service; 532 dressmakers and similar trades; 533 teachers, clerks, and professions; 32,279 of no stated occupation. The net result of last year's passenger movement between this country and places out of Europe was an excess (so far as British and Irish persons are concerned) outward to the extent of 139,365. As to the nationalities of the alien immigration, the following figures indicate the position so far as the bulk of the immigration is concerned:—

Nationalities.	1905.	1904.	1903.
Russians and Poles	37,922	46,095	30,046
Germans	6,932	7,084	7,502
French	6,261	6,564	6,495
Italians	6,055	6,300	7,045
Norwegians, Swedes, and Danes	4,925	4,827	4,702

As to the ports to which aliens, whether *en route* for other countries, or not so described, come it seems that in 1905 Hull received the largest number, 56,528; London coming next with 51,556, then Grimsby with 41,120, and Newhaven with 14,916.

THE WATER POWER OF NORTHERN ITALY.

The water power of Northern Italy is beginning to take its place as one of the main assets of the kingdom by reason of the effect exercised upon industrial development by the diminishing coal supply. In the Italian cotton trade, the fuel problem, which is rapidly advancing to a serious stage throughout Europe, is rendered scarcely of moment, through the rapid development of electrical energy generated by water power in the hills. All the newer cotton mills are run electrically, and many of the older ones are to be re-equipped with the same system to take the place of their steam plants. According to the American Consul at Milan, the outlook of the Milan cotton manufacturer upon the future is not clouded by any doubts of his ability to compete with the mills of other countries on the score of power cost. One of the problems connected with the more extended use of water supply in Northern Italy has been suggested by the danger that too much of the natural flow might be made use of, to the detriment of the inhabitants of the upper valleys, who need a considerable amount for irrigation. This difficulty has been avoided by a storage system which appears to be working successfully, and by means of which all interests seem to be cared for equally. One of these reservoir groups was established in 1889, and two storage basins were built with a combined capacity of 5,750,000 cubic metres of water to supply the city of Genoa with water and electric power. The company has resolved to re-equip its works and to bring them up to date, and to produce a total available power supply of 6,000 horse-power. Another company, which is exploiting the water supply of the Apennines has established plants at four points in that range. One of these stations will supply electrical power to Spezia, the principal military port and maritime arsenal of Italy, and the other three will be used to transmit electrical power into Genoa. These three stations have a capacity of 28,000 horse-power, and the storage reservoirs for water have a combined capacity of more than 30,000,000 cubic metres. Impetus has been given to water-power studies and electrical transmission by the news that the Italian Government, under the direction of the King, whose interest in such practical enterprises is notably keen, will invite the two principal railway companies in Italy to devote a large part of 1907 to the question of electrical traction, and to take up various projects for trials on a large scale. On the line of the Mediterranean Company there has been tried a third rail system for use in the service between Milan and lakes Maggiore and Lugano. After three years this

appears to have given satisfactory results. In Northern Italy, nearly all the small cities and a large number of villages are supplied with electric light, while many of them have installations of hydro-electrical power. Among the cities of from 10.000 to 50,000 inhabitants, so equipped, are Varcelli, Novara, Pavia, Bergamo, Brescia, Verona, Voghera, Mantua, Vicenza, and Intra. Hydro electrical installations have played a powerful part in the commercial andvancement of these cities. The city of Como, one of the principal silk centres of Europe, draws its electric lights and power from a station near Porlezza, on the Lake of Lugano, through a wire line twenty-seven miles long and at a tension of 2,000 volts. The station includes a canal and tunnels 11,000 feet in length, by which is utilised a typical mountain torrent with a fall of 835 feet. The station contains five groups of generators. The town of Lecco, distinguished for its manufacture of cheeses, takes its electric light and power from a water-power fourteen miles distant. The installation at Verona is slightly different from these others, as in that city there exists a canal for industrial purposes, with a fall of about 35 feet, which supplies a considerable number of factories. A part of the power in this canal is utilised to generate a triphase current at a tension of 3,000 volts., supplying about 1,000 horse-power, which is distributed to small industries in the city at an average consumption of 35 horse-power each. Conditions at Vercelli, Novara, and Pavia, all commercial centres of tributary importance to Milan, are closely analogous to those at Verona. The city of Brescia, with 67,000 inhabitants, in the upper Lombard district, is served by two hydro-electrical installations, and a third will soon be put into operation, and will embody the latest inventions and appliances for this sort of work. The station is at Ponte Caffaro, in the Giudicaria Valley, where there is obtained a fall of nearly 850 feet of water. About 10,000 horse-power will be supplied from this station. Bergamo, another of Lombardy's most enterprising small cities directly connected with the commerce of Milan, has several small stations which take advantage of water-powers in that vicinity, giving the city a total of 3 500 horse-power for industrial uses, transmitted in triphase currents at 7,000 volts. Apart from these installations, which serve the smaller cities, there are a number of others in Northern Italy which supply electrical power to groups of villages spread over a territory more or less extended. Throughout Lombardy important manufactures are depending more and more upon electrical transmission for their power, and everything like a complete list would be a very long one. One of the most interesting plants is at Gromo, noted as the first in Italy to use a current of 40,000 volts. The wire line supplies the Crespi textile mills at Nembro. Many others might be mentioned, for example, the great textile mills at Schio, Melegnano, Novara, Udine, &c., are all worked in this way, and every year sees electrical transmission developing towards the point where all the rich country centering on Milan will be rendered independent of diminishing coal supply and the increasing high cost of fuel. Of vital importance in any complete consideration of the water-powers of Northern Italy, as related to the industrial development of Milan, is the plan now well on foot to add 40,000 horse-power to the available motor-power which can be drawn upon by manufactories in the city. This plan comprises the use of the waters of the Adda River, which leaves the Lake of Lecco at the city of Lecco.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in April last:—

New Charts. — 1179—England, west coast:—Bristol channel. 555—Norway:—Dolm Sund to Lyngvær. 3567—Africa, north coast:—Marsa Matruh. 3560—Haiti or San Domingo:—San Pedo de Macoris. 3561—South America, east coast:—Entrance to the rivers Paraná and Uruguay. 1893—Chile; plans on the east coast of Chiloe island:—Port Quellon and approaches. 3324—India, west coast; Maldive islands; Mále and Fadiffolu atolls; (plan:—Mále anchorage). 1701—Anchorages on the west coast of Sumatra:—Rigas and Chalang bays; Tabekat bay; Tarusan bay. 3470—Celebes; Buton strait:—South Narrows; North Narrows. 1493—Japan, south-west islands; plans in Tanega shima and Kuchinoyerabu shima:—Nishi no amate wan; Mage shima Shimama road; O ura; Kuchinoyerabu shima; Kuchinoyerabu wan. 2724—Plans of bays and ports in Candia or Crete; new plan:—Sitia bay. 318—River St. Lawrence; the Traverses; new plan:—Beaujeu channel, West Narrows. 2732—Eastern archipelago; plans of anchorages in Bali, Lombok, Sumbawa and adjacent islands; plans added:—Segara bay; Badung road. 935—Eastern archipelago; harbours and anchorages between Bali and Timor; new plan:—Cyrus harbour. 957—Ports in the Philippine islands; plan added:—Port Banga.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—3497—England, east coast:—Hull road. 1758—Spain, west coast:—Arosa and Pontevedra bays. 3408—Leeward islands:—Puerto Rico. 1751—South America, east coast:—Saucé point to Martin Garcia island. 2839—United States, west coast:—Columbia river. 638—Africa, west coast:—River Congo and adjacent creeks. 1881 — Indian ocean islands:—Cargados Carajos shoals. 3296—Plans in Timor:—Koepang bay and approaches; Koepang road; Hansisi anchorage. 166—China, east coast:—Pagoda anchorage and approaches. 452 — Japan:—Yezo island with adjacent straits.

These charts are issued by Mr. J. D. Potter, 145, Minories.

HOME INDUSTRIES.

Shipbuilding.—Reference was made in these notes last week to Scotch shipbuilding during the first six months of the year, and to the outlook for the remainder of 1906. Taking a more general survey of the shipping industry, the returns compiled by "Lloyd's Register of Shipping" show that, excluding warships, there were 569 vessels, of 1,409,456 tons gross, under construction in the United Kingdom on June 30 last. Of this total 1,395,807 represented the steam tonnage, and with the exception of 513 tons the whole of it was steel. Of the 13,649 of sailing tonnage, 12,212 was steel, the rest being wood and composite. The tonnage under construction has steadily increased since December, 1903, and the present figures are within 4,000 of the total reached in September, 1901, the highest on record. All the great shipbuilding centres, Belfast excepted, show improvement as compared with the corresponding quarter of last year. There were 299,301 tons under construction at Glasgow against 269,659 tons at the end of June, 1905; at Grenock 228,620 tons as against 199,161 tons; at Newcastle 285,216 tons against 259,918; at Belfast 166,790 against 208,525; at Sunderland 179,864 against 160,386 tons; at Middlesbro' and Stockton 92,859 tons against 88,817; at Hartlepool and Whitby 80,815 tons against 63,350 tons. The improvement in the shipbuilding industry in the United States is remarkable. Upon the returns received it appears that whereas at June 30, 1905, the construction was only 35,682 tons, at the same date this year it was 124,237. Germany, too, shows considerable advance, as from 227,216 tons to 269,238 tons, but in France construction fell nearly 50 per cent., from 60,005 tons to 32,628 tons.

Trade Expansion.—The trade returns for June show that the expansion which has been so marked during the last two years gives no sign of slackening, but is rather proceeding at accelerated pace. June exports were valued at £30,639,000, as against £25,985,000 last year, and £24,070,000 for June, 1904, an increase of 17·9 per cent. if the twelve months is taken, or of 27·3 per cent. if the comparison is with June, 1904. The expansion for the first six months of the year amounts to £24,887,000, or 15 9 per cent., or as against the first six months of 1904 to £36,477,000, or 25·3 per cent. This growth is unexampled, exceeding even that of the earlier seventies when Mr. Gladstone spoke of trade growing by "leaps and bounds." The cotton industry has shown the greatest expansion in the half year to June 30, but there has been increase in all directions. Cotton exports have increased in value by over £9.000.000, or, as compared with the first six months of 1904, 24 per cent; iron and steel show an improvement of £4,323,000, or nearly 37 per cent.; woollens and worsteds of £2,789,000, or about 24 per cent.; machinery £2,449,000, or about 24 per cent. The value of the cotton manufactures exported in the six months to June 30, 1906, was £42,817,000, as against £39,591,000 in 1905; of iron and steel £16,096 as against £12,557,000; of woollen and worsted manufactures £10,176,000 against £9,680,000; and yarns £3,614,000 as against £2,866,000; of machinery £12,751,000 against £11,000.000; of new ships £5,811,000 as against £2,156,000; of railway carriages and trucks £1,625,000 against £720,000; of cycles and motor cars £901,000 against £632,000, the only head showing decrease being tin plates, exports of which have declined from £2,409,000 in 1905 to £2,322,000 in 1906. There has been a general expansion in the value of imports, the increase in the value of the imports of raw wool being no less than £3,484,000, a certain sign of the great activity of trade in this country at the present time. Of the increase of £28,000,000 in our imports in the first half of 1906, compared with the imports of two years ago, one half has been in raw materials, and much of the balance in semi-raw materials such as copper and tin.

The Butter Trade.—The report of the Select Committee on the butter trade indicates that in certain factories fat not derived from milk is added to butter, and the butter is then sold fraudulently as pure butter. The evidence taken by the Committee has also shown that certain firms are engaged in the business of teaching occupiers of factories how to adulterate butter with fat not derived from milk. The law against such mixtures cannot be put in operation because the mixtures are so skilfully compounded that the analysts cannot generally certify that they are not pure butter, and there is no power of entry into these factories unless it can be proved that the substance which is manufactured there is margarine. The Committee makes some very drastic recommendations. Among them (1) inspectors of the Board of Agriculture and Technical Instruction for Ireland shall have power to enter any premises where they have reasonable grounds for believing that butter is made, blended, re-worked, treated by any process, adulterated, or stored; (2) that no fat other than butter fat, and no vegetable or other oils, nor any substance capable of being used as an adulterant of butter, shall be brought into, or stored, or allowed to be in any registered butter manufactory; (3) that the addition to butter at any stage of the process of manufacture of any fat not derived from milk be expressly and directly prohibited; (4) that a warranty or invoice given by a person resident outside the United Kingdom shall not be available as a defence, and that penalties for the importation of adulterated butter shall be proportionate to the magnitude of the consignment; (5) that butter having been treated by any process shall not be allowed to be replaced in the original packages.

Tinned and other Foods.—The recent revelations as to the methods of Chicago food exporters have had, as was inevitable, serious effect upon blameless vendors of foods and food-stuffs generally. Not all the abominations alleged are peculiar to tinned meats. Fresh meat of unhealthy carcases may be imported, and diseased beasts slaughtered for sale at home. Nor is meat the only kind of food under suspicion. Corn-stuffs, biscuits, condensed milks, infant foods, all sorts of food-stuffs, are the objects of suspicion, and not only food-stuffs vended in close packages. How is the public to be reassured? How is the honest trader, careful to offer for sale nothing but sound food, to satisfy the public that he is not indifferent to his duty? The scare will die away by-and-bye, but meantime? A correspondent of *The Times* suggests what would seem to be a commonsense answer. He must put the evidence of purity before his customers and the public. "Repeated and extensive explanation, detailed description of factories, sources of supply, and methods of manufacture, must be made known, accompanied by anything which can be adduced as evidence and authoritative confirmation on matters of fact. And such details, accompanied by such evidence, must be continually published and re-published wherever the eye of the consumer can be attracted, and his deliberate attention engaged until it has become a matter of general knowledge that particular factories and vendors of the foods known by particular trade-marks are beyond question pure." That may involve expense beyond the resources of all but the biggest firms, but there can be little doubt that those who are able to take this course would find it greatly to their advantage.

The Motor Omnibus Industry.—Reference was made recently in these notes to the immense home industry that is growing up in connection with the motor-car business, but the terrible accident on the Brighton road the other day, and various mishaps of a less tragic but still serious kind elsewhere, are bringing into prominence the question whether these motor omnibuses will long be permitted to move about as unrestrained as they do at present. It is not only that fatal accidents from time to time remind the public of the dangers inseparable apparently at present from this mode of travelling, the discomfort they create in the streets, and to residents, cannot be overlooked. The letter of Sir Theodore Martin to *The Times*, in which he relates the experiences of residents in Onslow-square, gives expression to a widely-felt grievance, and as in the quiet squares and streets the motor omnibus is causing great annoyance, so in crowded thoroughfares, like the Strand, the reasonable objections to it are many. No doubt in course of time science will be able to lessen the danger of travelling by these vehicles, and the annoyance caused to the individual, but it may well be that before invention succeeds in this the objections to the motor omnibus will become so general and deep that Parliament will have to intervene and insist upon regulations which can hardly fail to check for the time being the growth of the industry. It is hardly to be doubted that we shall see improvements in the motor omnibus similar to those which have so completely changed the bicycle, but it is a question of when we shall see them, and whether in the meantime Parliamentary interference may not check in some degree the present rapid increase.

Macclesfield Silk Weaving.—In one of the reports published in the Factories and Workshops Blue-book for 1905, just issued, reference is made to the virtual disappearance of silk weaving in Macclesfield, an industry for which that town was once famous. The factories are now no longer occupied chiefly in weaving the silk, but in the making up of material of foreign manufacture into ties and "neck-wear" for both sexes. The hand-looms which used to occupy the garrets of many streets are silent; for the most part they have been taken down to ship off to America, where they and the Macclesfield weavers are said to have made of Patterson, in New Jersey, a new Macclesfield, which numbers amongst its inhabitants more handicraftsmen of the old town than remain there. The present trade of Macclesfield—the making up of neck-wear—is one which is pre-eminently the sport of the ephemeral fancies of fashion. Silk, and gauze, and chiffon, frilled and embroidered, tucked, hemstitched and embellished by devices of bewildering variety, are worked up into every conceivable form of accessory to ladies' dress. All hands are busy one week on designs that will never be seen again; they come and go; fashions here to-day and gone to-morrow. The Macclesfield inhabitants, both operatives and employers, need to be very versatile to adapt themselves and their business to the ever-changing demands made upon them.

Electricity and Laundries.—The use of electricity for power laundries is extending, and more than one firm has started motors, with their advantages of greater cleanliness and safety. The Electrical Exhibition at Olympia doubtless gave an impetus to the movement in favour of electricity. One laundry lately opened is an example of the many advantages derived from the exclusion of the web of mill-gearing found in so many factories, and should serve as a model for others. Two calenders are each run by a $1\frac{1}{2}$ horse-power motor attached to the machines. The hydro and other machines are also fitted with motors. The shafting is carried in an underground chamber with a controlling switch so placed that it can be easily thrown out of gear before the engineer goes down for oiling or other purposes. In this same laundry was also installed the new type of Blackman drying machine, worked by a $7\frac{1}{2}$ horse-power motor, and so constructed that the clothes to be dried are carried through the chamber by mechanical action, and drop into receiving bins on the further side. This does away entirely with the

necessity for the workers' employment in the superheated air used in the ordinary drying chamber—a part of the laundry which has probably given rise to phthisis more than any other.

Machinery and the Hosiery and Boot Trades.—Mr. Sedgwick, factory inspector at Leicester, gives some interesting particulars as to the effect of labour-saving machines in the hosiery and boot trades. As regards the hosiery trade, considerable displacement of labour has taken place owing to the introduction of new machinery having rapid and more complete powers of production in a number of country villages. Workshops which were formerly occupied by hosiery knitters, working the Griswold hand machine, have been closed for want of employment. For example, in a village situated a few miles from Leicester, four workshops used to be open, in which the number of male and female workers employed was about fifty-four. All four are now closed through lack of work, with but small hopes of any revival taking place. In other branches of the hosiery trade, new and improved machinery is being introduced which, slowly but surely, is displacing male adult labour. All the recently introduced machines are more or less automatic in action, and girls and women are as capable of working them as adult males, and at a much smaller cost. A somewhat similar state of things is to be found in the shoe trade. Nearly every year brings its changes in the form of machinery intended to produce boots and shoes of all kinds more rapidly. Here again, male adult labour is being supplanted more or less by the labour of boys and youths. A machine is nearly completed to be put on the market, for which it is claimed that with the aid of one man, it will produce as much work as is now done by five men, and that work of a good class. To-day a fairly skilled workman in the shoe trade, if over forty years of age, finds it difficult to get employment.

GENERAL NOTES.

Bermuda Industries.—The chief agricultural industry of Bermuda is the cultivation of onions, potatoes, and lily bulbs, and this industry has not been very flourishing of late. In his report on Bermuda just issued (Cd. 2684), the Colonial Secretary says that the Legislature placed at the disposal of the Board of Agriculture the sum of £1,000 to encourage the export of produce to markets other than those of the United States. Shipments of onions were made during the season to the principal cities of Canada, and a special agent went to Canada from Bermuda to superintend the distribution and sale of the shipment. A shipment of onions was also made to London during the year. But the results of both shipments proved unsatisfactory, and it is not likely that these experiments will be repeated. The lily bulb industry seems to be declining rapidly, the average quality of the bulbs having deteriorated. The cultivation is now only a source of profit to those farmers who give close attention to the quality of the bulbs planted and exported. Bermuda is a large grower of onions, and last year the crop was an unusually fine one. But prices fell to such an extent that it ceased to be profitable to export towards the end of the season, and large quantities of reaped onions were allowed to rot in the fields. Experiments in the growing of onion seeds have been continued in order that the farmers of the colony may be independent of seed imported from Teneriffe. The superintendent of the Public Garden is of opinion that the only obstacle to the successful growing of seed is the prevalent onion disease "thrip," and that the "sets," even in their dormant state, were infected with the disease. A preliminary experiment has been conducted of growing Sumatra rubber tobacco under tent cloth on the lines practised in Florida and Connecticut, U.S.A. The result of this experiment was on the whole satisfactory, and a further experiment on a larger scale will be made during the present year. Attempts are being made to resuscitate fruit cultivation, and to improve the methods for preserving fruit from the ravages of the "fruit fly." Attention, too, is being given to the cultivation of the Canary Island banana (*Musa Cavendishii*), which, in the opinion of Mr. Harris, superintendent of the public garden, thrives better in Bermuda than in any other part of the world. There is a good demand for this class of banana in the United States, but there are at present not more than 30 acres under banana cultivation in Bermuda.

Ashanti.—In his annual report just issued (Cd. 2684) the chief Commissioner of Ashanti, Mr. F. C. Fuller, gives a rather encouraging opinion as to the readiness of the Ashanti to turn his attention to the cultivation of the soil for economic purposes. Numerous new cocoa plantations were started during the year, namely, in the eastern and southern parts of Ashanti, and it is hoped that the high prices obtained in Kumasi will prove an incentive to the further cultivation of the plant. The natives have not yet learned to plant out young rubber or Kola trees, but every endeavour has been made to induce them to do so. The number of Kola trees in bearing increase automatically every year, and the young trees are watched over and well cared for by their owners, but systematic cultivation is desirable. The area of land under cultivation with farm produce is increasing, and food is becoming more plentiful in consequence. Both tobacco and rice (hill) are grown in the Jaman territory, but so far only for local consumption. Cotton has not yet been attempted on any large scale in Ashanti, although efforts have been made to distribute seeds. A botanical station is about to be established in Kumasi, when a strong endeavour will be made to augment the cultivation, and increase the production of the various agricultural commodities of Ashanti.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

MODERN WARSHIPS.

By Sir William White, K.C.B., F.R.S.

Lecture V.—Delivered February 26th, 1906.

In the earlier stages of the iron-clad re-construction the greatest attention was naturally devoted to battleships. It was realised, of course, that modern fleets required to have numerous cruisers attached to them, just as the fleets of earlier times had needed similar assistance; but, by common consent, all Navies for a time assumed that wood-built screw frigates, of which a number had been constructed and were available for service, would fulfil this requirement. The first step towards the construction of modern types of cruisers was taken in the United States towards the close of the Civil War, and the action was originated by the depredations on American commerce committed by the *Alabama* and other confederate cruisers. It was decided to build a number of cruisers of the *Wampanoag* class with wood hulls, powerful armaments, and high speeds. The close of the Civil War was followed by a reaction, public interest in naval affairs diminished, and the *Wampanoag* was the only vessel of the class completed and tried. In England the swift cruiser *Inconstant* was the reply to the *Wampanoag* class: she was superior in speed, armament and sea-going capability to the American vessels. About the same time it was decided to lay down smaller swift cruisers of which the *Active* and *Volage* were the first examples. The *Inconstant* was frigate built, with the principal armament on the main deck; the *Active* and *Volage* were large corvettes carrying their armaments on the upper deck. The speeds attained were about 15 knots for the smaller vessels and 16½ for the *Inconstant*. All these vessels were provided with large sail power as an auxiliary to steam, and were capable of making passages and manœuvring under sail alone. These pioneer vessels were followed by a few others of similar character; but the construction of cruisers was limited, for the most part, to small vessels adapted for distant service and for local protection of British interests on foreign stations.

The idea of giving protection to the vitals of cruisers by means of strong horizontal decks did not find favour in this country for many years. Italy had adopted the system in the battleships, *Italia* and *Lepanto*, but as a rule vertical side armour was preferred. Russia took the lead in building vessels of the "belted" cruiser class with narrow strips of vertical armour at the waterline. The *Shannon*, *Nelson* and *Northampton* (1873-4) were similarly armoured, and so were the *Imperieuse* and *Warspite* (1881), but as a rule protective decks were preferred to narrow belts for cruisers. In the *Comus* class (of 1876), and the *Leander* class (designed in 1878), *partial protection* was given to machinery, boilers, and magazines by means of horizontal protective decks placed near the water-line. "Protected" cruisers, fitted with strong steel decks extending throughout the length in the region of the water-line, began in the Royal Navy with the *Mersey* class of 1882. These vessels were of about 4,000 tons displacement, 18 knots maximum speed, and cost about £160,000. Successive classes of protected cruisers were laid down during the next 15 years; the size, speed, and cost were continuously increased, until in 1894 the *Powerful* and *Terrible* were built of 14,000 tons displacement, 22 knots maximum speed, costing about £700,000.

The Northbrook programme of 1885 included seven vessels of the *Orlando* class known as "belted" cruisers. Instead of depending entirely upon protective decks for the defence of their vitals, these vessels had narrow belts of side-armour in the

region of the water-line, for a portion of the length, associated with strong horizontal protective decks fitted at the upper edge of the armour belts. These vessels might be classed with protected cruisers because their belts became practically submerged when the coal bunkers were filled, and the depths of the belts were no greater than the vertical depths protected by steel decks in the other class. In 1888 a considerable step in advance was made by laying down the *Blake* and *Blenheim*, whose displacement exceeded 9,000 tons, the maximum speed being 22 knots, and cost £430,000. The primary defence to the vitals consisted of a steel protective deck having a maximum thickness of six inches; this was reinforced by special arrangements of the coal bunkers. The bunkers above the protective deck, near the sides, were intended to be kept full as long as possible, and the vessels were endowed with stability sufficient to retain coal in the upper bunkers as long as might be thought desirable. Similar arrangements were made in all subsequent protected cruisers including the *Powerful* and *Terrible*. It was proved by experiment that high explosive shells were "stifled" and their destructive effect greatly limited by this coal bunker protection. The upper bunkers obviously would be necessarily empty at times, but the strong protective deck then remained as a defence to the vitals, and it was cheaper as well as more effective than a narrow belt of side armour. In the *Blake* and *Blenheim* armour-protected positions were introduced for the secondary armaments of 6-inch quick-firing guns. The bow and stern chase guns were of 9·2-inch calibre with strong shields and armoured ammunition tubes were fitted.

When melinite, lyddite, and other high explosives were introduced it was preferred in France and in some other countries to protect the broadsides of cruisers with thin steel armour in order to compel the explosion of shells outside the ships. The *Dupuy de Lôme*, built for the French Navy about the same time as the *Blake* and *Blenheim* were built, had armour a little less than four inches in thickness on her sides; the whole broadside to the height of the upper deck was covered and the system of "complete protection" which had been adopted in the earliest ironclads was thus reverted to. Experiments showed, however, that such thin side armour as was necessarily adopted because of the limits of weight available, could be seriously damaged, and that great destruction could be wrought inboard by using cheap chilled cast-iron projectiles instead of high explosive shells. Considerable risks were run at that time in firing high explosive shells from rifled guns; the Admiralty, therefore, after full consideration decided not to follow the French practice, but to continue the protective deck system in association with armour protection for the armament in the forms of casemates, turrets, shields, &c.

At that period Italian naval construction was hampered by financial limitations, and the construction of large and costly battleships was necessarily suspended. Vessels of moderate size and cost, which were classed as cruisers but were capable of taking their places in the line of battle were, therefore, begun; in this way the Italians became pioneers in the construction of modern types of armoured cruisers. Moderate coal supplies sufficed for Italian requirements in Mediterranean service; whereas British cruisers had to be adapted for long-continued service in the ocean, and therefore had to be furnished with much larger coal supplies. It was not possible with the quality of armour then available to obtain the combination of adequate protection (by means of vertical armour over large areas of the sides) with large coal supplies, unless the size and cost of cruisers were greatly increased. For these reasons protected cruisers continued to be built. Improvements in the manufacture of steel armour by Harvey and Krupp made it possible in 1896 to protect considerable areas of the broadsides of British cruisers with armour capable of resisting the attack of 6-inch quick firing guns and chrome steel projectiles at fighting ranges, while keeping within reasonable limits of size and cost. As soon as this condition was fulfilled modern armoured cruisers, properly so-called, were introduced into the Royal Navy. The *Cressy* class, designed in 1896, were the first vessels of the type. Like their predecessors of the "protected" type they were fitted with wood and copper sheathing on the bottoms in order that they might keep the sea for long periods without any considerable diminution of speed in consequence of foulness of bottom. The *Cressy* class are of 12,000 tons displacement, 21½ knots maximum speed, and cost £760,000. Their side armour is six inches in thickness: of Krupp quality, proof against 6-inch quick firing guns at moderate ranges. The *Cressy* class are larger and more powerful vessels than the *Montcalm* class of the French Navy built at the same time. They are capable of manœuvring with

battleships, although classed as cruisers; in this respect they resemble the Japanese cruisers which took part with battleships in the actions off Port Arthur and in the Korean Straits. The adoption of wood and copper sheathing necessarily involved very considerable weight and cost, and was accompanied by an equivalent increase in displacement. These facts have been frequently overlooked when comparing the *Cressy* class with foreign armoured cruisers where the steel bottoms have been left unsheathed.

The *Cressy* class were followed by four armoured cruisers of the *Drake* class, having dimensions practically equal to those of the *Powerful* and *Terrible*, but with unsheathed steel bottoms. The protection to buoyancy and stability consists of 6-inch side armour associated with protective decks inferior in thickness to those of the *Powerful* and *Terrible*. The maximum speed named in the design was 23 knots; on trial 24 knots was attained, and this performance has been repeated on actual service. Exclusive of armament their cost is about one million sterling—40 per cent. more than the cost of *Powerful* and *Terrible*. This increase in cost is chiefly due to the introduction of side armour and to the increase in engine-power and speed.

The "County" class of armoured cruisers were designed immediately after the *Drake* class, for the special purpose of overtaking and destroying numerous foreign cruisers, having maximum speeds of 23 knots, which had been built avowedly for the purpose of preying on our commerce in case of war. Russia, France, and the United States had all built such vessels, carrying principal armaments of 6-inch guns. The defence of these foreign cruisers consisted either of side armour 4 inches or less in thickness, or of "protective decks" alone. It was decided, therefore, that the "County" class should have a uniform armament of 6-inch guns superior in power to these foreign rivals and better protected. The arrangements adopted in the "County" class for the defence of buoyancy and stability were also superior to the corresponding arrangements in foreign rivals, although inferior to those of the *Cressy* class. The displacement of the "County" class is 9,800 tons, the cost per vessel about £700,000, and the maximum speed on trial varied from 23½ to 24 knots. These vessels as completed more than fulfilled their intended purpose; they are described by French authorities as, on the whole, equal in fighting capability to the *Montcalm* class. The comparative weakness of their armour and armament, when contrasted with some foreign cruisers of equal displacement but much inferior in speed and coal supply, has been the subject of severe criticism. These adverse remarks, however, have not taken into account the governing conditions laid down for the class. As the responsible designer of these vessels the lecturer simply had to fulfil requirements formulated by the Board of Admiralty. His personal opinion was always in favour of the use of thicker armour on the hulls, the adoption of more powerful armaments, with acceptance of corresponding increase in size and cost. After a considerable number of the class had been built from the original designs, the Admiralty decided to modify them, increasing the thickness of armour to 6 inches; to substitute some 7½-inch guns for a certain number of 6-inch guns, and to accept lower speeds. In the modified design (*Devonshire* class) the displacement is 10,850 tons, and the speed is about half a knot slower. The armaments include four 7½-inch and six 6-inch guns, as against fourteen 6-inch guns in the earlier vessels, and the cost has been increased from £700,000 to nearly £900,000.

The latest types of armoured cruisers completed for the Royal Navy are represented by the *Duke of Edinburgh* class of 13,500 tons, 22½ to 23 knots speed, cost about one and a quarter millions; and the *Minotaur* class, now building, are of 14,600 tons with a designed speed of 23 knots, and an estimated cost of £1,300,000. Three still larger cruisers (the *Invincible* class) have been ordered recently for the Royal Navy. Their particulars have not been published, but it has been stated that they will exceed their predecessors in size, power, and speed. Their cost will probably be fully one and a half millions sterling exclusive of armament.

At present there is a tendency in some Navies to abolish the distinction between battleships and armoured cruisers, and to produce what are termed "battle-cruisers." This idea was advocated in France many years ago by Admiral Fournier, and has been revived recently by M. Bos, the Reporter on the French Navy Estimates for 1906. It has not been favoured by the British Admiralty, the latest programme of construction including not merely the *Invincible* class of cruisers, but the *Dreadnought* type of battleship. The cruisers are to attain considerably higher

speeds, but have less offensive and defensive power. The cost of the two types is probably closely approximate. The latest armoured cruisers will cost between three and four times as much as the *Blake* and *Blenheim* of 1888, and be about 60 per cent. greater in displacement. The *Blake* and *Blenheim* were described as "monster cruisers" when they were designed, and no one then dreamed of the increase in size and cost which would be made in seventeen years. Whether there should be a change of policy and a reversion to smaller and less costly cruisers is a matter on which widely differing opinions exist.

During the last three years a new class of eight small, swift vessels has been built for the Royal Navy, at a total cost of about two and a quarter millions sterling, exclusive of armaments. They are officially designated "scouts," are from 360 to 375 feet in length, 3,000 tons in displacement, the maximum speed being about 25 knots. The main conditions embodied in their design were laid down by the Admiralty; the designs themselves were prepared by four of the leading private firms, each of which built two vessels: the guaranteed results have been attained or exceeded. Their armaments include ten 12-pounders, eight 3-pounders, and torpedo ejecting tubes. At maximum speed they carry only about 150 tons of coal, which is a very small supply in relation to the corresponding development of 16,000 to 17,000 horse-power. Their total bunker capacity is said to be about 450 to 500 tons. In relation to their size and cost these vessels have exceedingly small offensive power, and the protection given to their machinery and boilers is very slight. It has been explained that they are to seek safety in flight from more powerfully armed vessels, and that their intended mission was to act as scouts or as the "eyes" of a fleet. In order to fulfil that service their coal endurance ought to compare favourably with that given to the battleships of fleets to which the scouts would be attached. Under the circumstances of actual service the scouts should not merely have sufficient coal to enable them to keep company with fleets at cruising speeds as long as the battleships could keep the sea, but should have coal supplies which would enable them to run "out and home" from the battleships at high rates of speed which would involve large consumptions of coal. The trials made by the scouts have shown conclusively that their coal endurance at cruising speeds is very much less than that possesed by the battleships: consequently the fundamental conditions necessary for service as scouts have not been fulfilled. In the United States three vessels intended for similar services are now under construction. In their design greater length and displacement have been accepted in order to provide very much larger coal supplies. The latest employment of the British scouts has been as flagships of torpedo flotillas. For that restricted service their size and cost much exceeds what is necessary. It is therefore reasonable to conclude that experience has led to a practical abandonment of the original intention to attach these vessels to fleets. The English scouts may be described as gigantic examples of the destroyer type, with somewhat more robust machinery, and their performances do not support any multiplication of the type. Experimental types of destroyers have since been laid down for the Royal Navy, as described later. For the time the construction of small cruisers has been suspended in the Royal Navy, but it is not probable that this condition of things will be perpetuated.

The device and development of locomotive torpedoes are due chiefly to the mechanical genius of an Englishman, Mr. Whitehead. His attention was directed to the matter by Captain Lupuis of the Austrian Navy, who was desirous of discovering a means of propelling small floating torpedoes along the surface of the water. Mr. Whitehead's first torpedo was constructed in 1886, was 14 inches in diameter, and weighed 300 lbs., with an explosive charge of 18 lbs. of dynamite. Its speed was six knots for a short distance. The Austrian Government were so impressed by these results that they decided to adopt and develop the invention. In 1869 the Admiralty appointed a Special Committee to experiment with two torpedoes, one of 14 inches and the other of 16 inches diameter; the smaller had a charge of 18 lbs. of dynamite, the larger 67 lbs. of gun-cotton. The average speed attained was $8\frac{1}{2}$ knots for 200 yards and $7\frac{1}{2}$ knots for 600 yards. The committee reported that a ship at anchor might be struck at any distance up to 400 yards, but that a ship steaming at moderate speed could only be struck with certainty at 200 yards. Torpedoes used up to that time had been either carried at the end of spars or towed into contact with an enemy, both methods of attack involving very close approach. Although the distances within which the first Whitehead torpedoes were effective were moderate when compared with

what has since been achieved, at the time of the introduction the gain in range of torpedo attack was very great, and its danger was increased by the fact that it was made under water and below armour.

The British Government at once purchased the rights of the inventor for £15,000, and made arrangements for manufacturing on a large scale. Great improvements have been devised since 1869. In 1876 14-inch Whitehead torpedoes attained a speed of 18 knots for a distance of 600 yards, the charge being 26 lbs. of gun-cotton. In 1884 a maximum speed of 24 knots was reached; in 1889 the speed was increased to 28 to 30 knots for 1,000 yards with a charge of 200 lbs. of gun-cotton. The latest English torpedoes have an effective range of about 2,000 yards and a maximum range of about 4,000 yards. A new turbine-torpedo on the Whitehead principle recently introduced in America is reported to have a guaranteed range of 3,500 yards with an average speed of 28 knots and a speed of 36 knots for 1,200 yards. The diameter of some of these American torpedoes has been increased to 21 inches; the charge being 132 lbs. of gun-cotton. The propelling turbine is said to run at a speed of 10,000 revolutions per minute. Besides increase in speed many improvements have been made tending to greater accuracy and efficiency. The power of maintaining a desired depth below water has been much increased, and by means of gyroscopic apparatus greater accuracy in aiming has been secured. In consequence of the largely increased range and offensive power of torpedoes, modern fleet actions have to be fought at greater ranges than formerly, in order that the danger of under-water attack may be minimised: this has had much to do with the improvements in naval artillery, gun-sights, and range-finders previously mentioned.

Great attention has been bestowed also upon means of defence against under-water torpedo attack. From their first introduction it was recognised that extreme water-tight sub-division in the interior of warships would be the most important means of defence. Experiments have been made with triple water-tight skins forming double cellular sides, the compartments nearest the outer bottom being filled, in some cases, with water, coal, cellulose, or other materials. Armour plating has been used both on the outer bottom and on inner skins. The Russian battleship *Cæsarevitch*, which was torpedoed outside Port Arthur at the beginning of the war, had this form of defence; a vertical wall of thin armour was built a few feet within the outer bottom from the bilge up to the height of the lower deck. It is claimed that this system of defence practically protected the interior of the vessel from serious damage by torpedo explosion. This is possible, but it is well known that, notwithstanding the existence of the internal armour, the *Cæsarevitch* had to be beached in order to prevent her from foundering, much as the *Retvisan*, which had no internal armour, had to be treated at the same time. Experience shows that although internal armour may stop fragments of damaged structure, and while the internal space may be correspondingly protected, yet the "jar" of an explosion inevitably produces leakage, especially in joints whereat the internal armour is connected with the lighter structure. An extended use of thin internal armour is also liable to produce serious effects on trim, heeling, and stability, when spaces adjacent to the bottom and sides of a ship are water-logged.

Up to date the balance of opinion has favoured minute water-tight subdivision and the multiplication of comparatively thin water-tight partitions rather than the use of internal armour, which use of course involves large expenditure of weight and cost. It is the fashion to speak of under-water torpedo attacks as involving practically the same risks of foundering to vessels of large or moderate dimensions. Increase in length and draught of course increase area of target exposed to torpedo attack. It is generally admitted, however, that while larger ships necessarily expose larger targets, their greater size and relatively more minute water-tight subdivision lessen the dangers of rapid foundering when struck by torpedoes. The same explosive energy has to be absorbed when a successful torpedo attack is made; but the larger vessel has greater chance of escape and of maintaining both flotation and manœuvring power, because the same amount of damage affects a smaller proportion of her total buoyancy. These considerations necessarily have certain limits in practical ship designing.

The introduction of locomotive torpedoes was followed by proposals to build vessels for their use. It was seen to be possible to employ the new weapons in vessels of small size and cost, as well as to add them to the armaments of larger warships. Sir John

Thornycroft began the construction of small swift vessels in which locomotive boilers and engines running at high rates of revolution were employed, and extremely high powers in relation to the total weights devoted to propelling apparatus were realised. Up to that time it had been common to fit steam launches with "spar-torpedoes"; that is to say, with explosive charges carried at the end of long spars which projected beyond the bows; these charges being exploded either by contact or by electricity. This form of attack, of course, necessitated close approach to an enemy. Another device, suggested by Captain Harvey and adopted to a limited extent, was that of "towing-torpedoes" which were towed at the end of long lines, made to diverge from the towing vessel and so to approach and strike an enemy's ship. The plan was feasible but was not adopted extensively.

The pioneer torpedo boat, built by Messrs. Thornycroft for the Norwegian Government in 1873, was 57 feet long, of $7\frac{1}{2}$ tons displacement, and 15 knots speed, and was intended to use a towing torpedo. In 1877 the first English torpedo boat, named the *Lightning*, was built by Messrs. Thornycroft. She was 85 feet long, 27 tons in displacement, attained 19 knots, and carried a bow torpedo tube for the discharge of Whitehead torpedoes. This new departure was followed by the principal Navies. Other designers and builders of torpedo boats took up the work initiated by Mr. Thornycroft both in this country and abroad. Amongst the more eminent of these competitors may be mentioned Messrs. Yarrow in England; Messrs. Normand in France; and Messrs. Schichau in Germany. The universal law of increase in size and cost of vessels has had its effect on torpedo boats. In 1885 it was decided to construct 54 first-class torpedo boats for the Royal Navy, and so to retrieve the position of inferiority into which we had drifted in consequence of having failed to develop an invention which had originated here while foreign countries had been making great efforts in building torpedo boats. Russia then possessed 115 torpedo boats; France 50; and England only 19. The type adopted in 1885 under the stress of threatened war, had a length of 125 feet, a speed of 21 knots, and a displacement of 60 to 70 tons. Ten years later, our first-class torpedo boats had a length of 140 feet, 130 tons displacement, and a speed of $23\frac{1}{2}$ knots. The latest vessels classed as torpedo boats in the Royal Navy are 165 feet long, of 200 tons displacement, and attain $25\frac{1}{2}$ knots. The latest type of French torpedo boats are of less displacement than the English, but have attained speeds of 26 to 27 knots.

In 1892 it was decided to begin in this country the construction of a new class of small, swift torpedo vessels of high speed known as "torpedo boat destroyers." They were designed, as their name implies, primarily for the destruction of torpedo boats. At that time the French had concentrated their principal fleets in the Mediterranean, and had formed a number of torpedo boat stations along their northern coast, with the avowed intention of using these vessels in raids upon British commerce and British ports in case of war. The destroyers were made larger and swifter than the French torpedo boats, and in addition to locomotive torpedoes carried a gun armament enabling them to overpower or destroy the largest torpedo boats then existing. The sketch design for these destroyers was prepared by the writer in the Admiralty, and used to formulate the governing conditions communicated to Messrs. Thornycroft and Messrs. Yarrow, when they were asked to submit designs and tenders for vessels of the class. These firms accepted the conditions, guaranteed their fulfilment, and became responsible for the designs. The first vessel of the class completed was the *Havock*, built by Messrs. Yarrow. She was 180 feet long, 240 tons in displacement, and attained a maximum speed of $26\frac{3}{4}$ knots. She was armed with one 12-pounder and three 6-pounders and carried three torpedo ejecting tubes. Her complement included 43 officers and men. The *Daring*, built by Messrs. Thornycroft at the same time, was somewhat larger, was fitted with water-tube boilers instead of locomotive boilers, and attained $27\frac{3}{4}$ knots. Experimental trials with these vessels proved that they were capable of fulfilling their intended purpose and of running down the swiftest torpedo boats then existing. Their large size gave them increasing superiority over torpedo boats as the sea became rougher, and they had superior coal endurance as well as more powerful armaments. As soon as the type had been established and justified by trial, steps were taken to rapidly increase the numbers of destroyers. Many of the leading firms of shipbuilders and engineers throughout the country were called upon to take part in the construction of these vessels. Early in 1896 22 destroyers were in commission and 48 were in construction before that financial year

ended. The class has since received fresh developments year by year, successive vessels being increased in size, speed and cost. The greater number of our destroyers are of the 30 knot type, 210 to 220 feet in length, 300 to 320 tons in displacement, and of 6,000 horse-power. A few vessels of exceptional speed have been built, amongst which the *Viper* (propelled by steam turbines) held the record, having attained in private trials a maximum speed of about 36½ knots. The *Cobra*, a similar vessel, designed and built at Elswick, was somewhat slower than the *Viper*. Her loss led to the construction of another type of destroyer with stouter hulls and heavier machinery in relation to power developed. These vessels are 225 feet long, and 25½ to 26 knots speed, with a displacement of 550 tons. The cost of the earliest destroyers was £36,000, the cost of the stronger and slower vessels last mentioned was £75,000. At the present time there are in process of construction for the Royal Navy three classes of destroyers. That termed "coastal" destroyers closely approximate in size and speed to the original type built fourteen years ago of which the *Havock* is an example, but they are to have turbine machinery, water-tube boilers, and oil fuel. These vessels are not equal in speed to the latest French torpedo boats, although of larger size and more powerful armament, whereas the *Havock* and her consorts of fourteen years ago had a distinct advantage in speed over the torpedo boats of that period. Another class now building is to have a maximum speed of 33 knots and are termed "ocean-going" destroyers. Like the coastal class these vessels are to have turbine machinery and to use oil fuel, and the cost will approach £125,000 per vessel. Further, a special ocean-going destroyer of 36 knots trial speed is said to have been ordered. The performances on trial of these faster vessels will be watched with great interest, more particularly as similar attempts made some years ago to build vessels of 32 to 33 knots with ordinary reciprocating engines and water-tube boilers resulted in serious disappointment and in the final acceptance of less speed than had been promised. The cost of the 36 knot type has not been officially stated but it must be very high, and the practical utility of the type should be demonstrated in actual service before it is multiplied.

At the present time the Royal Navy stands in a paramount position as regards the numbers and character of destroyers. In torpedo boats it is weak as compared with France and other powers. The "coastal" destroyers will really compare with foreign torpedo boats rather than with foreign destroyers. Taken as a whole, the British torpedo flotilla occupies a commanding position.

Because the sea-keeping capabilities of destroyers is considerable, it has been proposed to use these vessels as adjuncts to fleets and for scouting purposes. This was not the fundamental idea of their design, nor does experience justify the extension of their employment to ocean-going work. Prior to the introduction of destroyers, endeavours had been made to introduce torpedo "catchers," or torpedo gunboats, of which the *Bombe* of the French Navy and the *Tripoli* of the Italian Navy were early examples. In 1885 four similar vessels were begun for the Royal Navy. Of these the *Rattlesnake* was the most successful. She was 200 feet long, 550 tons in displacement, and 18½ knots speed, costing £35,000. She was armed with one 4-inch gun and six 3-pounders, and fitted with torpedo-ejecting tubes. In dimensions and displacement she was not far away from torpedo-boat destroyers built after the loss of the *Cobra*, and her cost was about one-half. Experience showed that the *Rattlesnake* class had not sufficiently good sea-keeping qualities. It was decided, therefore, to build the *Sharpshooter* class, in which speed, armament, and sea-going capability were increased. The *Sharpshooter* class are 230 feet long, about 750 tons displacement, and when fitted with water-tube boilers have exceeded 21 knots. The groups of locomotive boilers originally fitted in both the *Sharpshooter* and *Rattlesnake* classes gave considerable trouble. The *Speedy* (of the *Sharpshooter* class), fitted with water-tube boilers, was successful from the first, and several vessels of the *Sharpshooter* class which have been re-engined and supplied with water-tube boilers have proved equally satisfactory. The cost of the *Sharpshooter* class was £50,000 to £55,000. Their armaments include two 4·7-inch quick-firing guns, four 3-pounders, and three torpedo tubes. Trials made with the *Speedy* and *Havock* showed that, although the destroyer had a maximum smooth-water speed about six knots higher than the *Speedy*, a moderate amount of sea enabled the *Speedy* to overtake the *Havock*. For some years vessels of the *Sharpshooter* class have been engaged on coastguard duties around the shores of the United Kingdom. They have been very severely tested in heavy weather,

Thornycroft began the construction of small swift vessels in which locomotive boilers and engines running at high rates of revolution were employed, and extremely high powers in relation to the total weights devoted to propelling apparatus were realised. Up to that time it had been common to fit steam launches with "spar-torpedoes"; that is to say, with explosive charges carried at the end of long spars which projected beyond the bows; these charges being exploded either by contact or by electricity. This form of attack, of course, necessitated close approach to an enemy. Another device, suggested by Captain Harvey and adopted to a limited extent, was that of "towing-torpedoes" which were towed at the end of long lines, made to diverge from the towing vessel and so to approach and strike an enemy's ship. The plan was feasible but was not adopted extensively.

The pioneer torpedo boat, built by Messrs. Thornycroft for the Norwegian Government in 1873, was 57 feet long, of $7\frac{1}{2}$ tons displacement, and 15 knots speed, and was intended to use a towing torpedo. In 1877 the first English torpedo boat, named the *Lightning*, was built by Messrs. Thornycroft. She was 85 feet long, 27 tons in displacement, attained 19 knots, and carried a bow torpedo tube for the discharge of Whitehead torpedoes. This new departure was followed by the principal Navies. Other designers and builders of torpedo boats took up the work initiated by Mr. Thornycroft both in this country and abroad. Amongst the more eminent of these competitors may be mentioned Messrs. Yarrow in England; Messrs. Normand in France; and Messrs. Schichau in Germany. The universal law of increase in size and cost of vessels has had its effect on torpedo boats. In 1885 it was decided to construct 54 first-class torpedo boats for the Royal Navy, and so to retrieve the position of inferiority into which we had drifted in consequence of having failed to develop an invention which had originated here while foreign countries had been making great efforts in building torpedo boats. Russia then possessed 115 torpedo boats; France 50; and England only 19. The type adopted in 1885 under the stress of threatened war, had a length of 125 feet, a speed of 21 knots, and a displacement of 60 to 70 tons. Ten years later, our first-class torpedo boats had a length of 140 feet, 130 tons displacement, and a speed of $23\frac{1}{2}$ knots. The latest vessels classed as torpedo boats in the Royal Navy are 165 feet long, of 200 tons displacement, and attain $25\frac{1}{2}$ knots. The latest type of French torpedo boats are of less displacement than the English, but have attained speeds of 26 to 27 knots.

In 1892 it was decided to begin in this country the construction of a new class of small, swift torpedo vessels of high speed known as "torpedo boat destroyers." They were designed, as their name implies, primarily for the destruction of torpedo boats. At that time the French had concentrated their principal fleets in the Mediterranean, and had formed a number of torpedo boat stations along their northern coast, with the avowed intention of using these vessels in raids upon British commerce and British ports in case of war. The destroyers were made larger and swifter than the French torpedo boats, and in addition to locomotive torpedoes carried a gun armament enabling them to overpower or destroy the largest torpedo boats then existing. The sketch design for these destroyers was prepared by the writer in the Admiralty, and used to formulate the governing conditions communicated to Messrs. Thornycroft and Messrs. Yarrow, when they were asked to submit designs and tenders for vessels of the class. These firms accepted the conditions, guaranteed their fulfilment, and became responsible for the designs. The first vessel of the class completed was the *Havock*, built by Messrs. Yarrow. She was 180 feet long, 240 tons in displacement, and attained a maximum speed of $26\frac{3}{4}$ knots. She was armed with one 12-pounder and three 6-pounders and carried three torpedo ejecting tubes. Her complement included 43 officers and men. The *Daring*, built by Messrs. Thornycroft at the same time, was somewhat larger, was fitted with water-tube boilers instead of locomotive boilers, and attained $27\frac{3}{4}$ knots. Experimental trials with these vessels proved that they were capable of fulfilling their intended purpose and of running down the swiftest torpedo boats then existing. Their large size gave them increasing superiority over torpedo boats as the sea became rougher, and they had superior coal endurance as well as more powerful armaments. As soon as the type had been established and justified by trial, steps were taken to rapidly increase the numbers of destroyers. Many of the leading firms of shipbuilders and engineers throughout the country were called upon to take part in the construction of these vessels. Early in 1896 22 destroyers were in commission and 48 were in construction before that financial year

ended. The class has since received fresh developments year by year, successive vessels being increased in size, speed and cost. The greater number of our destroyers are of the 30 knot type, 210 to 220 feet in length, 300 to 320 tons in displacement, and of 6,000 horse-power. A few vessels of exceptional speed have been built, amongst which the *Viper* (propelled by steam turbines) held the record, having attained in private trials a maximum speed of about 36½ knots. The *Cobra*, a similar vessel, designed and built at Elswick, was somewhat slower than the *Viper*. Her loss led to the construction of another type of destroyer with stouter hulls and heavier machinery in relation to power developed. These vessels are 225 feet long, and 25½ to 26 knots speed, with a displacement of 550 tons. The cost of the earliest destroyers was £36,000, the cost of the stronger and slower vessels last mentioned was £75,000. At the present time there are in process of construction for the Royal Navy three classes of destroyers. That termed "coastal" destroyers closely approximate in size and speed to the original type built fourteen years ago of which the *Havock* is an example, but they are to have turbine machinery, water-tube boilers, and oil fuel. These vessels are not equal in speed to the latest French torpedo boats, although of larger size and more powerful armament, whereas the *Havock* and her consorts of fourteen years ago had a distinct advantage in speed over the torpedo boats of that period. Another class now building is to have a maximum speed of 33 knots and are termed "ocean-going" destroyers. Like the coastal class these vessels are to have turbine machinery and to use oil fuel, and the cost will approach £125,000 per vessel. Further, a special ocean-going destroyer of 36 knots trial speed is said to have been ordered. The performances on trial of these faster vessels will be watched with great interest, more particularly as similar attempts made some years ago to build vessels of 32 to 33 knots with ordinary reciprocating engines and water-tube boilers resulted in serious disappointment and in the final acceptance of less speed than had been promised. The cost of the 36 knot type has not been officially stated but it must be very high, and the practical utility of the type should be demonstrated in actual service before it is multiplied.

At the present time the Royal Navy stands in a paramount position as regards the numbers and character of destroyers. In torpedo boats it is weak as compared with France and other powers. The "coastal" destroyers will really compare with foreign torpedo boats rather than with foreign destroyers. Taken as a whole, the British torpedo flotilla occupies a commanding position.

Because the sea-keeping capabilities of destroyers is considerable, it has been proposed to use these vessels as adjuncts to fleets and for scouting purposes. This was not the fundamental idea of their design, nor does experience justify the extension of their employment to ocean-going work. Prior to the introduction of destroyers, endeavours had been made to introduce torpedo "catchers," or torpedo gunboats, of which the *Bombe* of the French Navy and the *Tripoli* of the Italian Navy were early examples. In 1885 four similar vessels were begun for the Royal Navy. Of these the *Rattlesnake* was the most successful. She was 200 feet long, 550 tons in displacement, and 18½ knots speed, costing £35,000. She was armed with one 4-inch gun and six 3-pounders, and fitted with torpedo-ejecting tubes. In dimensions and displacement she was not far away from torpedo-boat destroyers built after the loss of the *Cobra*, and her cost was about one-half. Experience showed that the *Rattlesnake* class had not sufficiently good sea-keeping qualities. It was decided, therefore, to build the *Sharpshooter* class, in which speed, armament, and sea-going capability were increased. The *Sharpshooter* class are 230 feet long, about 750 tons displacement, and when fitted with water-tube boilers have exceeded 21 knots. The groups of locomotive boilers originally fitted in both the *Sharpshooter* and *Rattlesnake* classes gave considerable trouble. The *Speedy* (of the *Sharpshooter* class), fitted with water-tube boilers, was successful from the first, and several vessels of the *Sharpshooter* class which have been re-engined and supplied with water-tube boilers have proved equally satisfactory. The cost of the *Sharpshooter* class was £50,000 to £55,000. Their armaments include two 4·7-inch quick-firing guns, four 3-pounders, and three torpedo tubes. Trials made with the *Speedy* and *Havock* showed that, although the destroyer had a maximum smooth-water speed about six knots higher than the *Speedy*, a moderate amount of sea enabled the *Speedy* to overtake the *Havock*. For some years vessels of the *Sharpshooter* class have been engaged on coastguard duties around the shores of the United Kingdom. They have been very severely tested in heavy weather,

and ample evidence has been given of their thorough sea-going capability. The problem at the time of the design was to produce the smallest class of swift vessel capable of being self-supporting at sea and accompanying fleets. It may be claimed for the *Sharpshooter* class that this condition has been fulfilled; while experience with destroyers has confirmed the conclusion reached twenty years ago that the dimensions adopted for the *Sharpshooter* class were about the minimum possible in vessels intended for independent sea service.

Importance was attached for a time to "second-class" torpedo boats which could be carried on board large sea-goiug ships, and lifted out for service when required. In their latest development these boats were about 60 feet long and 16 knots speed; the lifting weight was about 18 tons. Special lifting-appliances were required, of course, when such boats were carried, and these appliances involved considerable difficulty and cost. Steel-built second-class torpedo boats were also found ill-adapted for ordinary work required to be done by ships' boats, and it was decided to employ wood-built boats of special types which could use locomotive torpedoes when required, but be available also for the ordinary work of the ships. This multiplication of torpedo boats involved provision for their repair and maintenance, and led to the introduction of "torpedo-depôt" ships. A purchased merchant ship named the *Hecla* was first employed, and was equipped with a considerable amount of machinery and plant for repairs as well as with special lifting appliances. Large equipments of submarine mines, torpedoes, and stores were also provided. The vessel proved of great service, and her success naturally suggested that better results might be obtained if depôt ships were specially designed and built. The first vessel of that class completed was the *Vulcan* of the Royal Navy, a design worked out by the writer for a foreign Navy at Elswick in 1883, and was subsequently adopted by the Admiralty in 1887. Many of the detailed arrangements and items of equipment were modified, of course, to conform to the practice of the Royal Navy, but the dimensions and essential features of the design were unchanged. The *Vulcan* has been in continuous service for 15 years and has done remarkably good work. She is primarily a torpedo-depôt ship and torpedo-boat carrier; in addition she is a protected cruiser with a strong steel deck covering her vitals, and carries an armament of eight 4·7-inch quick-firers and 28 smaller guns. She is 350 feet long, of 6,600 tons displacement, has a maximum speed of 20 knots, carries a large coal supply, and is equipped with powerful hydraulic cranes for the purpose of lifting and stowing second-class torpedo boats and mining launches. The load of such boats carried high above water amounts to 150 tons, and the hydraulic cranes and their mechanisms approach the same weight. The vessel contains a floating factory capable of effecting repairs to torpedo boats, and of doing much to assist in repairs to the fleet generally. She carries 6 torpedo ejecting tubes (2 submerged) and is an excellent drill ship for torpedo work. She is fully equipped for submarine mining, has a torpedo laboratory, ample space for supernumeraries, is thoroughly self-supporting, and is an excellent sea-boat. Her cost was £370,000. Vessels intended for similar service have been constructed abroad, the most notable being the *Foudre* of the French Navy, which is 380 feet long, about 6,000 tons displacement, and 18½ knots speed. The lifting appliances of the *Foudre* are of a different character from those of the *Vulcan*, and are probably not so efficient or rapid in working; but the vessel has been of great service to the French Navy and has been employed in carrying to the Far East submarines much exceeding in weight any second-class torpedo boat. These fleet auxiliaries, although they have proved of great service, have not been multiplied. The latest repair ships added to the Royal Navy have been purchased merchant vessels of great size and cargo capacity, in which have been installed a large amount of machinery and plant. The appliances for lifting and carrying torpedo boats have not been developed as in the *Vulcan*, and no attempt has been made to provide offensive or defensive fighting capability. Recently proposals have been revived for introducing portable submarines to be carried on board ships and transported to their scenes of operation. If this idea should be practically applied arrangements similar to those which have been adopted for dealing with second-class torpedo boats would probably be found necessary. Hitherto, there has been no practical adoption of the suggestion, and small submarines have not been favoured by any great Navy. A second repair-ship is now being completed for the Royal Navy; she was purchased from the merchant service, and will be adapted for her special employment.

Other fleet auxiliaries have been introduced in recent years and will probably be multiplied. These include hospital ships, tank steamers for carrying supplies of oil and fresh water, and steam-colliers. Storeships and ammunition-ships are also likely to be employed. As yet only a few such vessels have been specially designed for their services, but there have been many suggestions that the best results would be attained in that manner. The resources of the British mercantile marine are so great and varied that they have so far met all requirements and will probably do so hereafter.

Submarines are the most recent type of vessels employed for war purposes. For centuries the idea of under-water attack has been in the minds of designers. One hundred and thirty years ago an American engineer (Bushnell) actually built a small submarine and used it in an attack on a British warship at New York. His countryman Fulton, one of the pioneers of steam navigation, also constructed experimental submarines about a quarter of a century later. At intervals during the nineteenth century other vessels of the type were built in this country and abroad. The modern movement which has resulted in the practical introduction of submarines into all Navies began about twenty-five years ago and is largely due to the invention of locomotive torpedoes. Until that time it had been necessary for submarines to come practically close to vessels attacked in order that the torpedoes they carried at the ends of spars protruding from the vessels might be exploded in contact or nearly so with the bottoms of ships. The use of locomotive torpedoes, of course, enabled attacks to be made from such a distance that the explosion of large charges did not involve danger to the submarine itself. Holland in America, Nordenfeldt in Sweden and England, Dupuy de Lôme and Gustave Zédé in France, and other inventors in other countries attacked this problem seriously; but the credit of having continuously studied the problem from the commencement and having finally achieved results which are far superior to those reached by any other individual designer undoubtedly belongs to Holland. His type has been universally adopted outside the French Navy, and his work has undoubtedly influenced French designs.

In 1888 the United States Navy Department called for competitive designs for submarines and about the same time the first modern French submarine was begun. Progress made in France was slow for some years, but was considered sufficient to justify further efforts. In 1896 competitive designs were invited by the Minister of Marine. Some of these designs were approved and made use of in building representative vessels, and from these beginnings existing types in the French Navy have been developed. In America the competition resulted in the official approval of the Holland type; and so, almost simultaneously, France and the United States embarked on the new scheme. In France the Fashoda incident of 1898 determined the naval authorities to proceed strenuously with the development of submarines; from that time onwards large expenditure has been devoted to these vessels. In the United States, after a few submarines had been ordered from the Holland Company, a pause took place. No doubt experience was gained in the use of the vessels during this interval. Subsequently four more submarines were ordered and the total built and building for the United States Navy at the present time is twelve. During the recent war between Russia and Japan a considerable number of submarines were built in the United States for these two powers and exported in sections. The Russians adopted the "Protector" type, devised by Mr. Lake; the Japanese are said to have preferred the Holland type.

In this country action taken abroad was carefully watched, but no start was made until the French were proceeding vigorously with the construction of submarines. Towards the end of 1900 it was decided to adopt the Holland type and to order five vessels identical in design with those which had been approved not long before for the United States Navy. These vessels were 63 feet long, of 120 tons displacement when in the diving condition, had gasoline engines of 160 horse-power, and a speed on the surface of about 8 to 9 knots, and submerged of 6 to 7 knots. The propelling apparatus was duplicated. When on the surface the vessels were driven by gasoline engines, but when diving they were propelled by electric motors, current being supplied by storage batteries. A single torpedo ejecting tube was fitted at the bow; compressed air was used for the torpedo ejection and for the purpose of expelling water ballast when required. All the details of the design had been most thoroughly worked out by Mr. Holland. The construction was undertaken by Messrs. Vickers, Sons and Maxim

who had acquired the right to use the Holland Company's patents; and the work was supervised by officers of the Admiralty. It was announced that these five vessels had been ordered chiefly to determine the real value of submarines in naval warfare and to ascertain the best means of meeting their attacks. Before these trials had been made, however, on any considerable scale it was decided to prosecute actively the construction of submarines for the British Navy, and it has since been announced that they will form an important part of the means of defence of our great naval ports, fixed mine fields being abolished. Considerable changes have been made in the designs; the vessels have been increased in dimensions and speed, and the numbers have grown rapidly. According to official returns on 31st March, 1906, there were built and building 40 British submarines and the estimates for the year 1906-7 contemplate the addition of 12 more vessels of the type. Particulars of dimensions and cost have not been officially published except to a limited extent and on special occasions. The latest information of this kind available states that displacements of 300 tons have been attained, the surface speed has become 13 knots, horse-power has risen from 160 to 850 horse-power, and the cost per vessel, originally about £34,000, may be assumed to have been more than doubled. It is claimed that many and substantial improvements have been introduced by the Admiralty and the builders, and it is reasonable to suppose that this would be so, more particularly as the completed vessels have been kept actively at work and large experience has been gained. In this country there has been systematic development of the submarine type and concentration of the design and construction in the hands of a single firm who have been aided by the staff of the Admiralty and by naval officers specially detailed for the purpose. In France, on the contrary, many types of submarines have been built from designs prepared by numerous competitors. It is now freely admitted that this has been a mistaken policy, and that the British method is superior. French naval authorities are now proceeding on lines similar to those adopted here: designs are entrusted to a few naval architects who have been most successful hitherto. In the immediate future it is proposed to construct two principal types in France namely, the *offensive* and *defensive*. The first will be of larger size and have greater radius of action, being intended for work at a considerable distance from the base; the second, or *defensive* class, is intended primarily for harbour and coast defence, and therefore requires less speed and radius of action. The French already have submarines exceeding in displacement the largest British submarines, but it is reported that designs have been prepared for vessels of 800 tons displacement, and that examples of the type will probably be put in hand. The German Navy Bill also provides for large expenditure on submarines; Russia is said to have a programme of a similar nature; and there is evidence on all sides that the type will be multiplied and more extensively used. It is, however, undoubted that submarines remain as they have always been the special weapons of the weaker naval powers who must act on the defensive. Naval supremacy on the high seas can never be determined simply by submarines. In order to secure the power of diving and navigating under water considerable and special risks must be accepted, and it is necessary therefore to entrust the navigation and working of submarine to officers and men trained for the purpose, cognisant of the nature of the risks to be run and disciplined so that the utmost care and skill shall be secured in operating the vessels. Large expenditure is inevitable, and the size and cost of individual vessels are being increased rapidly. In the financial year 1905-6 no less a sum than £600,000 will be spent on British submarines, and in the coming year it is proposed to spend £376,000. Up to June, 1905, over £807,000 had been spent. It is, therefore, probable that by the 1st April, 1907, more than one and three-quarter millions sterling will have been spent in this country on submarines, the first of which were begun towards the end of the year 1900.

The review of modern warships and their development attempted in these lectures has necessarily been sketchy and incomplete. It may serve, however, in some measure to sustain public interest in the Royal Navy, and lead to a closer study of the subject in the numerous official and private publications wherein it has been discussed. The preamble to the Articles of War declares that "it is on the Navy under the Good Providence of God that our Wealth Prosperity and Peace Depend." All who love their country and desire the maintenance of the Empire heartily endorse that sentiment, and are prepared, at all costs, to maintain British supremacy on the high seas.

THE BANKING SYSTEM OF JAPAN.

The modern system of banking in Japan dates from the promulgation of the National Banks Regulations in November, 1872. Banks of every description have, since then, been established in quick succession, and these with the Bank of Japan at their head now number 2,200. These banks are divided by their nature into two classes, namely those which have been established under the general banking laws, making it their object to facilitate the general circulation of money act chiefly as trading banks, and those which having been created under special banking laws have special objects and functions as agents for the supply of capital to particular enterprises. At the beginning it was decided to establish banks with a view to creating financial institutions for the development of trade, and facilitating thereby the redemption of Government paper money which had already been issued to an enormous amount. Accordingly in 1872 the Government, as stated above, promulgated the National Banks Regulations, which was modelled on the example of the National Bank Act ot the United States and provided for the conversion of the national bank notes into specie. In August, 1876, an amendment was made in the same regulations, by which the national bank notes could be opened on security of national loan bonds, and were made convertible into paper money then in circulation. This amendment gave a great impulse to the creation of national banks which increased rapidly until at length they numbered 153. Since, however, the bank notes were convertible into paper money, they were practically no more than inconvertible paper money, and as a natural consequence they began to depreciate as their amount in circulation increased with the rise of new national banks. Thereupon, the Government refused, on the one hand from 1880, to permit the establishment of new national banks, and decided on the other to resort to drastic measures for putting the currency system on a sound basis. A further amendment was made in 1883 in the National Bank Regulations, by which the privilege of issuing notes was taken away from the national banks, and granted exclusively to the newly created Bank of Japan, and a suitable method for the redemption of the National Bank notes was taken. Meanwhile private banks and banking companies which did not come within the purview of the National Bank Regulations had increased in number until in 1884 their number reached 954, and there were no general provisions to control such banks and companies beyond their subjection to the control of the local authorities. To bring them under more efficient control, the Ordinary Banks Regulations and the Savings Banks Regulations were promulgated in 1890, and put into force three years later. Side by side with these private banks, the national banks acted from the first as financial institutions established for the purpose of assisting general trade. When the terms of their respective charters expired, most of them continued business as private banks, and by February, 1899, national banks had ceased to exist, so that there is no longer any difference in the economic functions and legal nature between the former national banks and other private banks, all of which are now subject to the provisions of the general banking laws. The above statements refer to ordinary banks, but there exist in addition seven special banks, each of which was created by special law. According to the Japanese Ministry of Finance, the Yokohama Specie Bank was established in February, 1880, under the National Banks Regulations, but as the Government refused permission to issue notes, and the bank made it its chief object to act in the interests of foreign trade, it differed essentially from a national bank, which acts in the interests of general trade, and in view of this fact the Government issued the Yokohama Specie Bank Regulations in July, 1887, and made the bank assume a special position of its own. The special bank next created was the Bank of Japan. To remedy the state of confusion brought about by the rise of a multitude of small banks, standing each by itself, without any connection with the others, the Government decided in 1882 to establish a central bank, and in June of the same year promulgated the Bank of Japan Regulations, under which the bank was immediately established. The main objects for which the bank was established were to improve the relations between the different banks, to facilitate the circulation of money, to lower the rate of interest, to extend the business of bill discounting, to issue notes with a view to unifying the various kinds of paper money then in circulation, and putting on a firm basis the monetary system of Japan, and to take charge of the receipts and disbursements of the national treasury. The bank has, from the moment of its establishment, enjoyed full credit at home and abroad, and discharged with great efficiency its duties, as the Central Bank during the Chino-Japanese war, and later at the time of the Japanese monetary reform, as well as during the late war with Russia. Notwithstanding the arrangements for the establishment of banks acting in the interests of commerce, similar establishments were lacking in respect of agriculture and industry, and to remedy this defect the Government promulgated in April, 1896, the law of the Hypothec Bank of Japan and the Agricultural and Industrial Banks Law. The Law of the Bank of Taiwan (Formosa) was promulgated in March, 1897, two years after the Island of Formosa had been ceded. The bank was granted the privilege of issuing notes convertible formerly into silver *yen*, but now into gold *yen* (*yen* = 2s.). It was given charge of the receipts and disbursements of the national Treasury on the island, its position in this respect being similar to that held by the Bank of Japan in Japan proper. Deeming it advisable to establish a bank for the exploitation of the resources of Hokkaido, the Government promulgated in March, 1899, the Law of the Hokkaido Colonial Bank, under which the bank was established in the March of the year follow-

ing. Japanese industries having, in the meantime, made remarkable progress, an enormous amount of securities, such as shares and debentures, had been issued by various industrial companies, and yet there was no special institution for advancing money on these securities. The Law of the Industrial Bank of Japan was therefore promulgated in March, 1900, and the bank established under this law in April, 1902. The Yokohama Specie Bank and the other banks above mentioned, have each its own special object and functions, and are governed by special laws. A law dealing with Japanese banking business in foreign countries, was passed in March, 1905. It provides that, in regard to banking business carried on in foreign countries by Japanese subjects, special regulations may from time to time be established by Imperial ordinance, according to the economic conditions or commercial customs of such countries. An Imperial ordinance relating to the banking business in Korea of the Dai-Ichi-Ginkō (the First Bank) was also issued in March of the same year. As regards savings banks, the Savings Banks Regulations were issued in 1890, but on account of the postponement of the enforcement of the Commercial Law, they did not come into operation until the 1st of July, 1893. Savings banks, whose business it is to take charge of the deposits made by the public at compound interest, must be joint stock companies with a capital of not less than £3,000. Their directors are jointly under unlimited liability with respect to the obligations of the banks incurred during their term of office, and upon the lapse of two full years after their retirement therefrom, they are released from such liability. Savings banks must, as guarantee for repayment of savings deposits, provide themselves with interest-bearing national or local bonds, corresponding in value to at least one-fourth of the deposits received, and place them at the Deposit Office. In case, however, the said guarantee fund reaches an amount equal to at least one-half of the capital, commercial bills and reliable companies' debentures and shares may be used. Any alteration in the articles of association of a savings bank must be approved by the Minister of Finance. In other respects the regulations for ordinary banks are also applicable to savings banks. In 1905 the number of savings banks proper in Japan amounted to 475, and there were in addition 205 ordinary banks which are engaged in the business of savings banks in addition to their principal business.

COPPER MINING IN THE MEXICAN REPUBLIC.

Copper mining on a large scale is a comparatively new industry in Mexico, but the vigorous manner in which it is pursued has placed the Republic's annual production above that of Spain and Portugal, and ranks Mexico the second largest of the world's producers. The output in 1904 amounted to 50,945 long tons. Copper deposits occur throughout the country, and copper mines are found in nearly every State. The most important producers are in Sonora, lower California, Chihuahua, Michoacan, and Durnago.

The Greene Consolidated Copper Company's mine at Cananea, Sonora, is now the largest in Mexico. It also ranks fourth among the world's producers. The company's property includes thoroughly equipped concentration and reduction plants of the largest designs. The output of the mines during the year was 489,352 tons of ore and 147,099 tons of fluxing materials, limestone and iron. The ore treatment amounted to 207,224 tons net, and the output of concentrate was 59,065 tons, showing a ratio of 3·51 to 1. Since full operations were resumed the daily capacity has averaged 900 tons, at a cost of 0·78 dols. per ton.

The smelter treated 308,215 tons of ore and concentrate, an increase of 33·8 per cent. over the preceding year, at a cost of 1·40 dols. per ton less than the average for that year, but without any additions to the equipment.

The net profit for the year was 1,075,315 dols., in which the value of 107,988 dols. was made to cover depreciation of plant, leaving a balance of 967,327 dols. for distribution. The total capitalisation is 8,640,000 dols. Two 3 per-cent dividends, aggregating 518,000 dols., were paid during the year, the balance being applied to betterments.

In the Nicozari, Sonora, mine of the Moctezuma Copper Company, a new ore body of importance has been found, and production will be increased materially. On the completion of the railroad from Douglas to Nacozari, the smelter at the latter point was shut down, and the concentrate shipped to the Copper Queen smelter at Douglas. An enlargement of the Nacozari concentrator is under consideration.

At Boleo, Lower California, satisfactory developments have been made, and the mine is in a prosperous condition. The output of metallic copper for the year was nearly 11,000 tons. Much searching for copper was carried on in the Yaqui River district of Sonora, and some prospects are being exploited. At Triunfo, the Progreso mine, one of the oldest in Mexico, has resumed the payment of dividends, and, in addition to an output of silver, there have been developments of gold ore which promise well.

Las Vegas copper mine in Chihuahua, near the Conchos River, has now been rendered more accessible by the building of the Kansas City, Mexico and Orient Railway to Las Trancas. At Los Reyes, near Jiminez, the Gibosa mine has kept up its usual production, and extensive development work is being carried on. The Jesus Maria copper mines, at Baguerachic, on the line of the Kansas City, Mexico and Orient Railroad, has been explored by an American company. This property was operated in 1864 by Baron Necker, and trouble regarding ownership was an excuse for the French intervention. The

mine is still handicapped by its distance from a railroad, but as the main line of the Stilwell road (now building) passes over the claims, it will in time become a producer of importance. This railroad between Urique and Choix, passes through a district in which other large copper deposits have been discovered. North-west of Ahumada, on the Mexican Central, San Antonio capitalists are opening a new district, and have already found some oxidised ore, assaying 10 per cent. copper.

A light railroad has been built from Otto Station, in Coahuila, on the Mexican Central Railroad, to the mines of the Jimulco Mining Company. The line is operated by a Shay locomotive, sixty tons of ore being shipped daily to Aguascalientes, containing 0·15 ounces silver and 16 per cent. copper.

At Alvino, Durango, irregular shipments of copper have been made to Aguascalientes. The Descubridora mine, at Conejos, has been worked intermittently, but it is now closed down. In Guanacevi some promising copper ores carrying gold and silver, have been opened near the town. At Velardeña the copper deposits of the Velardeña Mining and Smelting Company have proved to be extensive. Gas producers and engines of large capacity are being installed, and the enterprise is being developed rapidly. Plans have been prepared for the construction of a new smelting plant, but work has not yet been started. Large bodies of silicious ore are also being opened on the Teneres mine, and on account of the successful result of the tests made on the San Nicolas lead sulphide ores, a mill is to be built at once to handle a large tonnage. Improvements and development work for 1905 will entail the expenditure of 2,000,000 dols.

Development is again being carried forward energetically by the French company operating the Inguaran mine, in the State of Michoacan, the ore bodies being of great size. They assay approximately 5 per cent. copper, but better railroad facilities are required for the final success of the enterprise. Surveys have been made with the object of securing an outlet to the coast at Sihuatenejo, in Guerrero.

The principal copper property in operation in the southern part of the Republic is the Teziutlan, in the State of Puebla. The railroad has been completed to the smelter, and additional machinery installed.

The Campo Morado property, in the State of Guerrero, is still in process of development, a large additional tonnage of copper iron ore having been opened up. La Dicha mine, of the Mitchell Mining Company, 55 miles east of Acapulco, on the Pacific coast, has been actively exploited. Much work has been done at this property, and a smelter with a 200-ton daily capacity is almost completed. At Mazapil operations are prosperous, the copper matte produced being shipped to Aguascalientes, while exploration work is active. North of Zacatecas the Magistral mine is shipping 100 tons of copper ore weekly, and a mill has been erected on the Zaragoza mine, at Zacatecas, to concentrate 200 tons weekly of 4 per cent. copper ore.

The Cobre mines at Tepezala, Aguascalientes, have again resumed shipments of copper ore, and extensive exploration work is in progress. The Fortuna mine is making its regular production of 800 tons monthly of silicious copper. The Merced mine, supping 600 tons per month, is also in a prosperous condition.

STATE RAILWAYS.

Reference has recently been made in the *Journal* to the conversion of Italian railways into State institutions, and to suggestions for a change in the status of the Irish railways. In Germany with the decision of the Bavarian Government to purchase the railways of the Bavarian Palatinate the Government monopoly of German railways has become practically complete. There now only remains an insignificant part of the whole railway system in private hands. In referring to this conversion in his report on the trade of Germany just issued (No. 3656, Annual Series), Mr. Consul-General Oppenheimer says that since the completion of the Government monopoly there is a decided tendency towards uniformity in German railway matters, and most probably eventually the administration will be managed by a central Board, which would effect a great saving. Such an arrangement would more particularly benefit smaller railway systems, the percentage yield of which at present remains considerably below the Prussian, and in some cases hardly suffices to pay an income upon the capital outlays. Mr. Oppenheimer points out what economic importance such an unified working would be once the whole German net has been centralised. To-day the competition amongst the various nations often depends upon questions of traffic. Germany would then own a system complete, reliable, cheap, and profitable beyond all others. When the Protective duties were introduced, freedom from Customs' dues was granted to shipbuilding materials, to vouchsafe the existence of German yards, or at least to enable them to compete against foreign yards under similar conditions. The large iron syndicates have granted to ship-building yards the benefit of their foreign prices, a concession aimed more particularly against British competition. At the same time cheap rates of carriage facilitated the chances of German iron-rates, which applied from the place of production to the coast. What these concessions are effecting in reducing the total of imported ship-building material may be gathered from the following figures. In 1898 the import still amounted to 1,300,000 met.-centners, valued at 15,500,000 marks. In 1904 the import only amounted to 283,000 met.-centners, valued at 4,900,000 marks. The value of plates of sheet iron amounted in 1898 to 4,200,000 marks, in

1904 to 450,000 marks. The import of angle and corner iron receded in value from 1,000,000 to 144,000 marks. Fifty-six per cent. of the materials imported in 1904 came from Great Britain.

When the change in the railway system was initiated, the fact that the Government would employ a whole army of workmen was one of the main arguments against the scheme, and to-day the Prussian State Railways constitute the largest employer in the world. Mr. Oppenheimer gives the number of people employed in 1906 as 411,000, among whom 247,000 are workmen proper. The sum total of payments made to officials and workmen has been estimated at 586,000,000 marks. It was anticipated that with State employment on this vast scale, the German Parliament would in time develop an increasing interest in railway matters, but in the various parliaments efforts have been directed rather to tariff reductions and the like than the conditions of employment. A determined agitation has been initiated in favour of the producing classes, and as far as the carriage of goods is concerned the agitation aims at permitting special productions to the benefit of the exceptional tariffs, or to admitting specific goods to the lower tariff classes. As far as the carriage of passengers and passengers goods are concerned, the various allied Governments have repeatedly exchanged opinions, but for years it seemed impossible for them to agree, as the tariffs within the various States differed considerably, and the Governments were afraid to handicap their annual budget by consenting to lower rates. The main difference concerns the rates for express trains. In Prussia there exists an increased rate for these trains in the case of single tickets, but the increased rate does not apply to return tickets. Saxony and the Southern German States levy express rates of varying amounts. For the fourth-class tickets now in use in Prussia, Saxony, Oldenburg, and Alsace-Lorraine, a uniform rate of 2 pf. per kilometre (less than a ½d. a mile) applies throughout. For the first time during last year a successful attempt has been made to unite the various Governments upon the basis of the following rates :—For first-class, 7 pf.; second-class, 4·5 pf.; third-class, 3 pf.; fourth-class (unchanged), 2 pf.

The hopes in which the public indulged when the Government monopoly was first initiated have until now only been partially fulfilled. Mr. Oppenheimer explains that the Governmental railway administrations were first compelled to convert the capital outlay into a sound investment, and then attempted to derive from it very substantial profits. Moreover, the railways have not been worked purely as instruments of traffic, as some had hoped. Prussia, for instance, which owns the most extended system, derives an annual income which has been variously calculated to amount on the average to from 7 to 10 per cent. of the expended capital. For 1905 it was calculated at 10·2 per cent. From 1887 to 1889 the Government Railway Administration paid into the Exchequer 3,100,000 marks, equalling 1·19 per cent. of the gross surplus. In 1904 the Exchequer claimed 35 per cent. of the gross surplus, amounting to 176,200,000 marks, and to that extent the burden of the tax-payer has of course been lightened. Another advantage of the Government system lies in the fact that, through its railway tariff policy it enables special consideration to be given to other questions of a purely economic kind. For example, the development of particular industries has been greatly assisted by special tariffs (often resorted to when there was a desire to facilitate the export trade); it has also been enabled to pay special attention to exceptional circumstances such as bad harvests, scarcity of food and fodder, inundations, and so on.

AMERICAN COTTON.

The final report of the American Census Bureau shows that the cotton crop of 1905 was 10,697,013 bales, including 279,836 round bales, compressed as half-bales, 112,539 bales of Sea Island cotton, and 230,497 bales of linters. There were also included in the total 40,112 bales which ginners reported as remaining to be ginned. The gross weight of the 1905 bale is 503·8 lbs., which is slightly different from that of last season. The above figures represent the crop of 1905, and differ somewhat from the commercial crop, which includes the cotton carried over from 1904 to be sold in 1905. The commercial crop is estimated at between 10,800,000 and 10,900,000 bales. The Census figures may safely be assumed to be a very close approximation of the total yield of cotton in 1905. The production of cotton has therefore been in round numbers 10,700,000 of current gross weight, equivalent to 10,770,000 bales of 500 lbs. each, as against 13,584,457 bales of 500 lbs. each in 1904. The average price of cotton per lb. during the years 1901-5 was as follows:—9½c., 8c., 8½c., 12c., 9c. In May of last year the annual meeting of the Inter-State Cotton Seed Crushers' Association took place in New Orleans, and was attended by a large number of oil-mill managers, brokers, and dealers interested in the manufacture and handling of cotton-seed products. Certain modifications were made in the rules governing the export trade, such as the extension of the time limit allowed for the inspection of railway waggons from 20 to 30 days still further facilitating the export business through the port of New Orleans. Negotiations have also been entered into with some of the European exchanges with a view to the adoption by them of the New Orleans Board of Trade classification of cotton-seed meal and cake, such classification to be taken as a basis of settlement in case of dispute as to quality. Arrangements have been made to analyse all cotton-seed meal by qualified inspectors, who then issue their certificate of value, instead of the former practice of fixing the value of the meal by its appearance.

THE GERMAN CEMENT INDUSTRY.

It has been stated that the Portland cement industry in Germany is the most mysterious and difficult industrial branch for a foreigner to investigate, and many obstacles are placed in the way of obtaining any definite knowledge concerning the trade. The cement factories are organised into more or less loosely established combinations or associations which, in some instances, have taken the form of syndicates. All the statistics in each group are the carefully guarded property of each branch syndicate, and are not published in any united or consecutive form. The American Consul-General at Berlin says that Germany has in all 320 cement mills, in 117 of which Portland cement is manufactured. The production of the syndicated Portland cement factories in 1904 was 27,950,000 barrels, but figures for the entire German output are not obtainable. The lowest point in the history of the cement industry of Germany, at which the aggregate sales of all the factories bore the lowest proportion to the total capacity of production, was in 1902, when the sales were only 50 per cent. of the whole production. The percentage was but little higher at the close of 1905, but during the present year the cement business has somewhat improved, owing in a great measure to the effects of the mild winter upon building operations. The industry, however, is said to be very much overdone, and although German cement ranks very high in respect to quality, home competition and the pressure of outside factories are so great as to keep the price down to a very close margin of profit, and to render the position of the great manufacturers constantly difficult and embarrassing. The Consul has been told that cement is sometimes sold in Berlin at a profit of only sixpence per barrel to the manufacturer. The prices vary greatly according to the district in which the product is sold. Portland cement was recently quoted in Berlin at 5s. 6d. per barrel of 375 pounds, including packing. During the past year the prices in that city averaged from 4s. 10d. to 5s. per barrel free at the building, including barrel. In the price of cement, bags are usually valued by the manufacturers at about 2½d. each, and barrels at 3d., and are taken back at the same price, free of charge, if they are returned in good condition within six weeks after being used. Towards the close of 1905, the Imperial Railway Administration asked for bids for eleven million pounds of Portland cement. The prices offered by the manufacturers ranged from 26s. to 33s. per metric ton (2,204 lbs.). The imports of cement into Germany, which includes Roman, Portland, and hydraulic cement, the different varieties not being separated in the official Customs statistics, were, in 1905, 148,000 tons, as compared with 60,000 tons in 1904, and 50,000 tons in 1903. The principal countries of origin in 1605 was Belgium, which sent 65,000 tons; Austria-Hungary 34,000 tons; Switzerland 15,000 tons, and France 12,000 tons. In 1905, Germany exported 618,000 tons of the three different kinds of cement, in 1904, 580,000 tons, and in 1903, 686,000. The principal countries to which the cement was sent were Belgium 44,000 tons, Holland 104,000, Brazil 47,000, and the United States 86,000. During the past year the exports to the United States show a gradual falling off as compared with former years. In 1904 they were 94,000, in 1903 222,000, in 1902 247,000, and in 1901, 109,000 tons. Other countries to which German cement was exported in 1905, were Denmark, Finland, British South Africa. Portuguese East Africa, British Malacca, China, Dutch India, Chile, Mexico, France, Norway, Sweden, Russia, Spain, Cameroons, British India, Hong Kong, Philippine Islands, Argentina, Uruguay, Venezuela, and Australia. The countries of destination of German cement are given in detail to indicate the number of distant markets to which the German manufacturers resort to sell their products, with many of which they have direct communication in steamers flying their own flag. As regards combination with foreign producers, the Rhenish-Westphalian Cement Syndicate, the South German Cement Sales Office at Heidelberg, and the Belgian Cement Syndicate, in order to enable them to carry on their Dutch trade under more satisfactory conditions, entered into an agreement in the spring of 1905, to establish a sales office at Rotterdam, through which the current business in Holland of the three associations is to be transacted up to the year 1913. In April, 1905, a meeting of representatives of the English and French cement industries was held for the purpose of discussing the possibility of making some arrangement by which the production of cement in the respective countries could be regulated and prices maintained. For a time the negotiations remained without result, but finally, in November, 1905, an agreement was made with the German and Belgian interested parties, by the terms of which the French and English cement trade in Holland was also regulated. At various times during 1905 endeavours were made to get the various German cement associations together, so as to form a general syndicate for the whole of Germany. Towards the end of October, 1905, a loose arrangement was brought about among the associations to apportion the markets in the different German districts, to which, however, the South German, the Rhenish Westphalian, and the Lower Elbe syndicates did not subscribe. Inasmuch as, after great efforts, on the 30th October, 1905, the latter-named association entered into the arrangement, the whole of Germany is now covered with a network of agreements, which have to some extent strengthened the confidence of the manufacturers in the maintenance of fair prices. Toward the end of November, 1905, many complaints were heard from the cement dealers, as in consequence of the agreement between the different German cement associations, the middlemen were excluded. The union of German dealers in building materials, which includes 700 firms with an annual consumption of 1,300,000 tons of cement, planned the organisation of a buying syndicate, and demanded from the cement

manufacturers an extra rebate of from 6 to 10 per cent for its members. The syndicated factories refused to comply with the request of the dealers' union, so new conflicts would appear to threaten the German cement industry. The union dealers are discussing the advisability of erecting their own cement factories, but up to the present no actual steps have been taken.

THE FRENCH MATCH MONOPOLY.

According to statistics recently published by the French Minister of Finance, the total receipts of the match monopoly in France during 1904 amounted to £1,423,000. The profits were £1,048,000. Official estimates for 1905 give the receipts as amounting to £1,427,000 with the profits slightly in excess of those of the preceding year. Her average consumption per head in 1904 was 1,006 matches, representing an individual outlay of about tenpence. Wax matches came in for less than 4 per cent. of the quantity sold. The value of the exports amounted to £104. There are six match factories, all owned and worked by the State. They employ 750 men and 1,429 women. The wages paid to the workpeople per day of ten hours each average 5s. 3d. for the men, and 4s. for the women, which is stated to be practically double the average wages received by women in France. A pension is paid to workpeople having attained sixty years of age. Free medical treatment is provided for all *employés*. It has been estimated that it costs the French Government at least £7 to manufacture a million matches of the cheapest kind. That is held to be excessive, at any rate it does not compare well with the results obtained by private enterprise in other countries. The American Consul at Havre says that is a fact that the French factories have repeatedly been supplied with foreign matches at a price under £5 12s. per million. This has led to several attacks on the management of these establishments. The latest of these was made in the Senate by M. A. Dubost, who was at the time Chairman of the Finance Committee. He criticised severely what he termed the "anti-commercial character of nearly all State establishments," and after having referred to the difference in the cost of production under State and private management concluded as follows:—"I long ago stated in this House that our State industries are a cause of ruin to the Treasury. I say now that it is our duty to change our course, and to turn over to free industries and free commerce the largest share of the production of our State industries." The profits of the match industry are relatively so large that some persons assert that no attempt is made to give the public a fair equivalent for its money. The French matches are of such poor quality that they have become one of the jokes of the country. Moreover, the importation of foreign matches being the sole prerogative of the Government, very few are placed on the market. This monopoly being in the nature of a tax, has been accepted good naturedly ever since its establishment in 1872.

HOME INDUSTRIES.

Shipping.—Whilst shipbuilders are turning out more tonnage than ever before shipowners have to reckon with a period of depression likely to continue for some time and to become more acute. During the last two years the output of new tonnage has been enormous. It is true there was a larger total under construction in 1901 but then there was not nearly so much tonnage actually afloat. As compared with a year ago the tonnage of classified merchant vessels afloat has increased from 36,000,893 tons to 37,554,017 tons, but there has been no corresponding increase in the freight to be carried. It was assumed that after the conclusion of the war between Russia and Japan there would be a great improvement in international trade, and this expectation created a great demand for new ships, but the expansion of the carrying trade though as great as could be reasonably expected was less then sanguine forecasts. Last year was not a bad year on the whole for shipowners but it was not as good as it was expected to be, and this year, though international trade is not good from the shipowners' point of view things are going from bad to worse. It is complained that the liners are securing the cargoes that the tramps used to get, but liners cannot run on ballast if they are to pay their way. The crux of the situation is that there are too many vessels to carry the cargoes offering. The owners of cargo tramps have been too sanguine. At a time when the signs pointed to over supply of tonnage they did not hesitate to add to their fleets, and nothing but an abnormal expansion of trade upon which it was unreasonable to reckon could have saved them from the disquieting position in which they find themselves. And it is not only that British shipyards have been active. As was shown in these Notes last week, improvement in the shipbuilding industry in the United States and Germany during the last two years has been remarkable, and although up to the present British shipping holds its own the rivalry of foreign shipowners becomes more formidable yearly. In many ways they are fighting their British competitors under favourable conditions. British owners, having their new vessels, dispose of their secondhand ships to the foreigner, who is able to enter into competition with them on a lower capital expenditure and with lower working expenses; often the foreigner is subsidised by his Government, and always he is free of statutory obligations which hamper the British owner. The Merchant Shipping Amendment Bill now before Parliament may assist the British owner somewhat in this respect, but that remains to be seen, and it is not certain that the Bill will become law this session. No doubt in time things will right themselves, but only when there is a slackening of orders for new ships. Meantime, and notwithstanding the soundness of international trade, and probable improvement, the shipowner will have to face anxious times. He has to face them periodically for the consequences of over-building are not to be avoided, and he is among the most sanguine of traders.

Cotton Industry. — The cotton trade continues very active, but there are some slight indications of quieter times in the not distant future. The Board of Trade returns for June show that the yardage shipped was substantially lower than in the same month of last year (446,340,000 yards as against 503,266,700 yards), although the total for the six months was larger (3,116,703,600 as against 3,005,471,300), and there are not many new projects for cotton spinning building, which is not strange seeing that the number of new concerns which have got to work during the last twelve months, and are now in course of erection, is 78, representing 6,668,800 spindles. It is to be noted that the export of textile machinery continues large, and is much larger than last year. Taking the six months ended June 30 the value of such shipments in 1904 was £2,389,348; in 1905, £2,487,209; whilst this year it has risen to £3,152,131. India, the United States, France, Germany, Japan all have taken more in 1906, Russia being the only country which has taken less, a fact explained by the internal condition of the country. Shipments of yarn in June (14,901,500 lbs.) were below those of the corresponding month of last year (15,302,500 lbs.), but the six months to June show a considerable improvement upon last year's figures, 105,196,000 lbs. as against 97,867,100 lbs. The prospective supply of the raw material is promising. Given good weather, more especially next month, American estimates of the next crop put it considerably higher than the crop of 1905-6, and the reports from elsewhere are encouraging. With probabilities pointing to an ample supply of the raw material, and no present fear of serious labour disturbances, the good times the cotton industry is enjoying promise to continue for some time to come, but it is as well perhaps that there is a lull in mill-building projects. When all now in course of construction have got to work, there should be no lack of them for the work to be done.

Electric Light Wiring. — The London County Council (General Powers) Bill just passed by the House of Lords authorises those metropolitan Borough Councils with municipal electricity works to wire houses for electric lighting. These powers have been long sought by the London County Council, but until now they have been refused by the House of Lords. London municipal electric supply authorities may now wire the premises of consumers and prospective consumers for electric light, and supply fittings, motors, and other accessories, provided only that they do not manufacture them. It is contended by those interested in limiting the activities of municipal bodies that these powers are opposed to the spirit of the Electric Lighting Acts, which intend that the business of the electric supply "undertaker" shall be that of supplying electrical energy to the consumers' terminals only; but it is admitted that in small towns, in which there are no firms competent to do the internal work, it is admissible that the same authority who supplies the electricity should do the house wiring. The President of the Local Government Board has explained that the object of obtaining these powers is to dispense with the middleman, that is to say, the wiring contractor, who, however, is said to work under severe competitive conditions.

Life Assurance and the State.—A Select Committee of the House of Lords is now making inquiry into matters connected with the position of British policy holders in life assurance companies having their chief offices outside the United Kingdom, and one of the principal questions which the Committee is desired to consider is whether such companies should be required to make special deposits of funds in Great Britain in conformity with a custom which is enforced as regards foreign insurance companies in many other countries. The opinion of the majority of the managers of British life offices would appear to be against the proposal, nor are its advantanges obvious. The scandals in connection with life insurance which have so disturbed policy holders in foreign companies of late are associated almost entirely with American offices, and with offices which, whatever may be said in criticism of their management, are admittedly perfectly solvent. In what way would their English policy holders have been in a better position if they had had to make special deposits of funds in Great Britain? There have been instances recently where policy holders in life offices have been in jeopardy, and where they have been losers, but in these cases the trouble was due to a radically unsound system of assurance. It is here, as it will seem to many, that the existing law requires to be strengthened. Not long ago a trading company did an immense business under a system of life insurance which no actuary could be found to say was sound, yet apparently the Government were powerless to interfere. The usual deposit of £20,000 was lodged with the Board of Trade, but that was a mere bagatelle towards meeting liabilities when the inevitable crash came. What is wanted is power for the Board of Trade, or some other Government authority, to interfere when schemes of this kind are brought to its notice and put an end to them; but the condition of such interference should be that the system condemned is so plainly unsound that competent experts are united in their rejection of it. The principle underlying the Act of 1870 is that insurance offices should act as they think right provided they make known what they are doing, and subject to the limitation named above, and to adequate information as to their methods of valuation and the management of their funds, this would seem to be a sound principle.

Trade with Egypt.—An Alexandria correspondent of *The Times* directs attention to the many vexatious and unreasonable regulations which hamper the sale

of manufactured articles in Egypt. These regulations would seem to date back to the days of the Khedive Ismail, when no doubt it was necessary to frame stringent rules and regulations as some sort of check to the methods of corrupt officials and contractors. The specifications which the Government require are said to be overloaded with involved conditions difficult to understand, and which often frighten serious competitors, who do not realise that many of them are more formidable in appearance than reality, whereas those who know the ways of the country disregard them, and so obtain unfair advantage. Many British manufacturers are anxious to tender for the supply of manufactured goods to the Egyptian Government, but are prevented by the conditions imposed. The correspondent gives many instances of the one-sided character of these conditions. For example, the first thing a contractor has to do is to pay into the Treasury 10 per cent. of the value of his tender, and if his tender is accepted he has to deposit 20 per cent. of the value of the contract. This payment must be made within five days, and remains in the hands of the Government for a period of twelve months in respect to most contracts, no interest being allowed. Then goods to be supplied must be exactly like the Government samples in every respect, a practical impossibility. Many of the Government standard samples were selected and sealed at least fifteen years ago. Then the contractor is bound to supply at the same price, and under the same conditions, any further quantity up to 40 or 50 per cent. of the articles ordered which may be required in excess of the quantity originally specified. But there is no indication when the extra quantity will be ordered, or if it will be ordered at all. Orders for the supplies must be executed within 90 days, and payment is made for the goods within a "reasonable" time but in practice, if the correspondent is correct, the official interpretation of a reasonable period is very elastic. Payment is frequently withheld for months after the goods have been delivered and accepted, and it is not uncommon for contractors to be informed during the months of November and December that they must wait until the new year's budget comes into operation, which means a further delay until the end of January. The Government also reserves the right to cancel the contract on giving thirty days' notice to the contractor, and although this condition appears never to be put in force the fact that the Egyptian Government retains it may well prevent cautious but leading firms from tendering. The time allowed for delivery of the Egyptian Government's orders again is unreasonably restricted, and in the event of delay its custom is to inflict a fine of 2 per cent. of the value of the undelivered goods for every day of delay. Any sum thus deducted from the deposit must be replaced within three days, otherwise the Government may immediately cancel the contract and confiscate the whole of the deposit money. The correspondent makes out a strong case for revision of conditions of tender which seems to be no longer suitable to the requirements of to-day, but in Egypt, owing to the peculiar position of the Government in relation to foreign powers, it is exceptionally difficult to bring about changes in the law, and any considerable change in the conditions under which manufacturers wishing to do business with the Egyptian Government have to work is likely to be delayed.

GENERAL NOTES.

Hong Kong.—If allowance is made for the abnormal conditions of 1904, the figures given by the Governor of Hong Kong in his annual report (Cd. 2684) show that British shipping entering and clearing from Hong Kong more than held its own in 1905. The actual number of ships of European construction entering during the year was 889, of which 506 were British and 383 foreign. It is interesting to note that 116,790 trees were planted during the year, and 50,052 in the new territory. Further experiments were initiated with a view to utilising the more barren parts of the colony, notably with the tea oil tree (*Camellia oliefera*) and the wood oil tree (*Aleurites cordata*). Cotton was tried in various representative situations, but with very meagre results. Control of the plantations of pine licensed to Chinese in 1904 was maintained. A few breaches of the rules which occurred were dealt with by a withdrawal of the license. On the whole the licensing scheme seems to have suited the Chinese. The present population, including New Kowloon, and the remainder of the New Territories, is estimated at 462,861; according to the census taken in 1897, it was then only 248,880, which in 1901 had increased to 283,975.

Manganese Ore.—The existence of manganese ore in St. Helena has been known for years, but no serious effort has been made until recently to work the mineral, or even to ascertain in what quantities it exists. It would seem, however, that serious attempts are now being made to ascertain the value of the deposits, and, in his report on St. Helena just issued (Cd. 2684), the Governor says that large deposits of good quality have been found. The expenses of working the ore are much lower than in other places where it is found, say Cape Colony. There 3s. a day is paid for labour, and it is necessary to bag the ore and transport it by rail to the port of shipment. In St. Helena, labour can be obtained at from 2s. to 2s. 6d. per day, and it would not be necessary to bag the ore, as it could be placed on board ships anchored quite close to the works. But everything depends upon the quality of the ore. The Governor's report is dated from The Castle, St. Helena, 8th March, 1906, but the present writer is informed upon authority that the analysis of samples brought to this country during the last few weeks proves that the ore is of too poor quality to be worked profitably.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

SECTIONAL COMMITTEES.

INDIAN SECTION COMMITTEE.

The following is the list of the Indian Section Committee, as appointed by the Council:—

Sir Steuart Colvin Bayley, K.C.S.I., C.I.E. (Chairman of the Council).
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W. Martin Wood.
S. Digby (Secretary).

INDIA'S COTTON INDUSTRY.

By S. M. Johnson.

(President of the Upper India Chamber of Commerce.)

It is right in a conference* assembled to consider the agricultural and industrial interest of this great continent, and the measures which might be taken to further advance those interests, that those taking part in it should bring prominently to notice any disabilities under which either or both may appear to labour, or any dangers which may threaten or appear to threaten their welfare, and to put forward suggestions for the best means of removing them in the one case or averting them in the other.

One of India's greatest industries, if not the greatest, is cotton spinning and weaving, and if we reflect that, after food, clothing is our next greatest need, and that in India cotton fabrics form practically the sole raiment of all its millions, we must admire nature's wonderful gift of the raw material; for not only can the people of the country grow their own sustenance, they can grow their own covering as well. With such conditions India should be not only the greatest cotton-producing country in the world, but it should also be the greatest cotton-spinning and manufacturing country in the world; and because it is neither the one nor the other that I am induced to ask you to consider the causes.

To-day I must confine myself to the industrial part of the problem, leaving consideration of the cultivation of India's great staple to some other occasion.

The cotton industry, we all know, is divided into two great sections—cotton-spinning and cotton-weaving. Cotton is now almost entirely spun in India by machinery; hand-spinning still survives in parts, but it is a moribund industry, and does not require to be considered.

Weaving in this country is divided into two branches, viz., power-loom weaving and hand-

* Industrial Conference of the Indian National Congress held at Benares in December, 1905.

loom weaving. The proportion of hand-loom to power-loom cloth in India is about three to one, that is to say, there is about three times as much hand-loom cloth made in India as there is power-loom. There is no question but that power-loom cloth can be made possibly better, certainly cheaper than hand-loom cloth ; but owing to the disability under which industries labour in India and which I shall treat of presently, the power-loom is not worked to its full productive capacity, hence it has not outstripped the hand-loom in the same way as machine-spinning has outstripped hand-spinning, and that is the reason why the production of the one is three times that of the other. I know it will be said that perhaps, on the whole, it is good for India that it should keep to its hand-looms, but that is a proposition that is quite unsound. It is the same question that European countries have had to face before now, and as they have solved it so also will India solve it. If a man with the aid of certain contrivances can make and earn six or ten times as much as another without those contrivances, which think you will gain the day? If power-looms were worked to as great efficiency in India as they are worked in Western Countries, hand-weaving would now be a decaying industry, hand-loom weavers would be finding more lucrative employment on power-looms, and India would be making more cotton fabrics and importing less from abroad than she does at present. These remarks bring me to the two great matters concerning India's welfare which we should ponder over. One is a present disability, the other a prospective danger.

The greatest disability which affects Indian industries is the poor quality of Indian labour. It is one which perhaps in the course of time will undergo alleviation, but the process must necessarily be a slow one, and unless we realise how great a disability it is and strive to remove it, the process must be slower than it need be. Until our labouring classes learn to value thrift, to value labour, and to value time, they can never hope to compete with Western nations. I have mentioned these three attributes because I think they may be considered as summarising all that we care to find in labour. A man who is thrifty will always strive to improve himself as a wage earner; if he values labour he will strive to excel whatever his occupation, and if he values time he will strive to do as much as he can in the hours at his command.

These virtues you must all know are conspicuous only by their absence among labourers in India. Go where you will—search where you may—you will find everywhere the same complaint, and that is the poor quality of labour, and it is poor because the labouring man is not thrifty—he only values money for whatever it can give him at the moment without a glance at the future; he does not value work for work's sake—to him it is unfortunately a matter of complete indifference whether his work is bad or good; he does not value time because his practice is not to do as much as possible in a given time, but as little as possible.

With disabilities such as these can Indian industries ever hope to compete with those of Western nations? I am afraid not. If we are ever able to compete, it will be due to some circumstance, some factor which is so predominant that even the poor quality of our labour will not entirely outweigh the great benefit accruing therefrom.

To illustrate the position I will take the case of a cotton weaver in Lancashire. A power-loom weaver there works single-handed from four to six looms, and will turn out from each an average of 78 lbs. of coarse cloth in a week of 55 working hours or 468 lbs. in all for a six-loom worker. A power-loom weaver in India looks after, as a rule (at all events, in the part of India I am familiar with), only one loom, and all he can turn out of a similar cloth in a week is at the best 70 lbs. A hand-loom weaver on an improved hand-loom can weave barely 60 lbs. of very coarse cloth in a week; his out-turn as compared with a power-loom weaver's 70 lbs. But comparing either with an English weaver I ask you to consider the wide difference; it is that a weaver in Lancashire can do the work of at least six Indian power-loom weavers and nine hand-loom weavers.

Do you think the Indian workman in whatever handicraft he may be employed can ever hope to compete with the European, if the disparity between them is so great, if the efficiency of the one may be taken as six times that of the other?

And remember this difference is not due to any difference in machinery—the power-loom in India is similar to the power-loom in England, and cotton mills in India are as well equipped as cotton mills in England, the difference is due entirely to the quality of the labour.

India can never become a great industrial nation until its labour improves—it will never be

able to utilize its vast stores of raw material until the Indian labourer is a better working man than he is at present. The disability our industries lie under is the poor quality of our labour, and the great question is how it is to be improved. I have had many thousands of Indian workpeople under my observation, and the one invariable feature I have found is that beyond a very limited extent, and only in rare cases, there is never any improvement—the man of 40 is generally not as good as the man of 30—the man of 30 not as good as the man of 20. What is wanted is to improve the condition of the lowest classes; it is not higher education that is wanted nor the teaching of the well-to-do, it is the children of the cultivator in the villages, and the children of the artizan and the cooly in the cities, who require to be brought within the fold, and educated so that they will not be divorced from the calling of their parents, but sent back to it with all possible speed. The defect in our present system of education is, I think, that under it these classes escape: it does not reach the lowest stratum, and many of those who are taught are too old and are taught too much, and their aims misdirected. The elementary schools I refer to should never take a child under seven and never keep him after nine, and he should be taught only the simplest elements, given plenty of physical exercise, and then allowed to go back to assist his parents in their calling and be trained in it whatever it is.

I believe if these preparatory schools, especially in cities, were established, and the absolute rule observed not to take a child over seven or keep him after nine, that in a few years you would find the intelligence of the labourer really improved, and that a start once made it would go on improving and extending from year to year.

I have treated of a disability and now I will refer to a danger. The danger that appears to loom large in India's future is the danger that her destinies will be directed not so much by what is best for her, but by what is best for other people. I am not going to launch into a tirade against Government. Our Indian Government is I suppose the finest and most beneficent in the world, and British statesmen and British officials are the most upright in the world, but Governments in India are ruled by the party in power in England, and parties in England are entirely a matter of votes. When therefore you find British voters insisting on a particular policy, you may be quite certain their representatives in Parliament will support that policy. It is some years now since an Excise duty was put on Indian-made cotton cloths; it was put on because an import duty was put on imported cotton cloths, and Lancashire said that if an Excise duty was not put upon the local article there would be an unjust competition between the two.

The import duty was put on for revenue purposes and not by way of protecting Indian-made goods, but remonstrance and protest were equally unavailing; it was of little use pointing out that there was no competition because similar goods were not made in India, the electors in Lancashire insisted that there should be a duty, and a mandate from the British Government was issued accordingly in opposition to the views and desires of British officials in and the people of India.

Though from year to year the campaign against Excise is carried on as vigorously as it is possible for us to do, there appears no prospect of relief, and now we are face to face with trouble, and this is the danger to which I ask your attention and which threatens the vitality of your industries. You have no doubt heard of the long factory hours recently practised in Bombay—I have nothing to say in support or defence of a fifteen-hour day: the practice of these long hours brought down violent, not to say hysterical, condemnation in Bombay itself, and they cease to be practised, but the echo of them is now reaching us from Lancashire, where the most determined efforts are being made to induce the British Government to interfere with the hours of factory labour in India. The ground on which the Home Government is asked to interfere with our hours of labour are stated to be humanitarian, and there are loud clamours that the hours in India should be similar to those in Lancashire, viz., ten hours a day. Though ostensibly this interference is based on grounds of humanity, the real feeling among Lancashire workpeople (and one has only to read its newspapers to see it) is that long hours of work in India mean undue competition with them, and for that reason should be stopped. Let us examine therefore these two pleas, first the humanitarian one and then the undue competition one.

To those who know the condition under which the factory hand works in Lancashire the plea of humanity appears a hollow pretence. Both men and women have to work there ten

hours daily from year's end to year's end except on Saturdays, when they work from four to six hours. At six in the morning summer and winter they must be at their work or run the risk of losing their job: steadily so long as the engine revolves they must work—work—work, there is no rest, no cessation, no respite. At eight, they are allowed half an hour for breakfast, and about noon, one hour for dinner, but for ten hours there must be steady continuous grinding work. There is nothing in India to compare with the life of factory hands in Lancashire, and as to factory girls, their lot is indeed a pitiable one. In a recent Lancashire paper I read that for the loss of an eye a woman weaver got compensation at the rate of two shillings a week for six months; in the same paper there was a report of a case at Rossendale, where a girl of fifteen attempted to commit suicide because she was threatened with dismissal for not turning out enough work, and, in the same paper, another case at Elton, where a girl of fourteen was killed doing what, in India, would be a man's work. Similar cases are frequently reported, and reading them, my profound conviction is that it is the factory workers in India who ought to go to the rescue of their fellow workers in Lancashire, and claim on humanitarian grounds that the work there should not be so strenuous, that women should not be employed on men's work, and that intervals should be allowed for recreation.

Indian factories are built in spacious grounds where the workers have unlimited means of recreation, where they bathe, wash their clothes, eat their meals, sleep, and in fact live. The Indian mill to its workers is their home. Look at the other picture; land in England is so scarce and so costly that actual building space only is, as a rule, taken up for a mill; the sides of the factory itself frequently forming the boundaries of the property, and the workers stepping usually from the mills into the street. That a hand in England should quit his machine to eat, to sleep, to bathe, to wash clothes, to smoke, is an unheard-of thing; they are at work continuously from the time they step into the mill, to the time they step out again.

Women by customs of caste and other considerations do not work in any part of a weaving mill out here, nor in any part of a spinning mill except the reeling room. In Lancashire they work everywhere. A woman weaver there is often better than a man, and does quite as much. Where does the plea of humanity come in?

As to competition, it is not the Indian labourer who competes with the English worker; it is precisely the opposite which is true. If under present conditions, and working 72 hours a week, an Indian worker can turn out at the very best only 70 lbs. of cloth, while the European, working 54 hours, can turn out 468 lbs., what truth is there in the plea that the Indian competes with the European. Is it not the plain, palpable fact that even now competition would be utterly, hopelessly impossible but for some other predominant factor? In the case of cotton, it is because we have the raw material; but if that factor were to disappear, and our industries so fettered by unjust laws that the Indian labourer was placed on the same level as a European labourer, then our industries would disappear as in a twinkling, and the people would have to go back to the land or emigrate. Let me give you an illustration. It costs in Lancashire the equivalent of 14 pies to make a pound of coarse cloth such as is worn by the lower classes in India. This figure does not include the cost of the cotton or the yarn, but simply the cost of making the cloth, and all processes previous thereto, including such items as wages, stores, and coal. In India a similar cloth would cost at least 17 pies; but the cotton or yarn in these cloths is so much cheaper in India than in England that the higher cost of production in India is more than made up in the price of the raw material.

That is one of the reasons why England cannot compete with India in coarse goods; but if this difference were to disappear, which it does as you get up to finer counts, then India could not compete at all.

If you take the cost of freight to India, landing, and agency charges, and all other expenses, and also exclude Excise duty, you need only add at the outside 20 per cent. on to prime cost, and in the case I have given you that would mean under 17 pies against 17 pies, so that but for the raw material European countries could at the present moment land cotton goods in any part of India cheaper than they could be made on the spot.

There are very laudable attempts being made to introduce improved hand-looms in India, and I see it stated by Mr. Chatterton, Mr. Havell, and others, that with improved looms the hand-loom woven cloth can compete with that from power-looms. But it is a vain hope;

if the power-loom weaver would work even two looms he could nearly treble the outturn of the hand-loom; it is because he confines himself to one loom that he pulls the power-loom down to the producing power of the hand machine.

But notwithstanding this the cost of weaving on the power-loom is less than on the hand-loom. In a report to the Government of Madras the other day Mr. Chatterton said that in Ahmednagar, on some improved hand-looms, coarse cloth had been made at a cost of about 19 pies per pound; the figures he gives, however, do not include cost of repairs and renewals, cost of general charges, management and the like. Nor did it make provision for the days when the looms would be idle. If hand-looms were worked together on a large scale the cost of making cloth on them would certainly always be higher than on the power-loom. Taking a similar cloth to that made at Ahmednagar the cost of making it on a power-loom would be 17 pies, as against the hand-loom's probable 21 pies, the equivalent of the English cost for a similar article being about 14 pies.

What our European rivals dread in India is not the hand-loom but the power-loom, if by any means—by curtailing factory hours, by interfering with adult labour, by Excise duties—the latter could be crushed, then the hand-loom industry would be entirely at their mercy; nothing could possibly save it from rapid extinction.

If, therefore, the hours of labour in India were restricted so that the output of the labourer out here were made to be even less than it now is, it is obvious the factor of the value of the raw material would be a diminishing one; the point would be reached when the saving in cost of manufacture would more than cover the difference in cost of raw material, then what would happen? Your industries must disappear. If cotton yarns and cloths could be landed in India for less than they could be spun and made here, do you think cotton-spinning or power-loom or hand-loom weaving could continue to exist in India? They would disappear like the morning mist.

In interfering with the hours of factory labour in India I am afraid Lancashire lays itself open to the charge of having one object—one aim, and that is to destroy India's cotton industry.

These, therefore, are what we have to bear in mind in developing or endeavouring to develop India's industries. There is first the disability we are under of having poor labour; until we make the Indian labourer a more intelligent and better workman than he now is, we shall never be able to compete with European nations.

And there is second the danger of such interference by outsiders with our labour laws as will enhance the cost of our manufactures, and thus bring our markets within easier reach of the skill of Western nations.

COAL-TAR COLOUR JUBILEE.

The international celebration of the 50th anniversary of the discovery by Sir William Henry Perkin of the dye-stuff "mauve," by which the foundation was laid of the coal-tar colour industry took place last week. A public meeting was held at the Mansion-house in February under the presidency of the Lord Mayor, and the method of celebrating the jubilee was then decided on. It was recommended that Dr. Perkin should be presented for his lifetime with an oil portrait of himself, the portrait to become the property of the nation at his death, that a marble bust of him should be executed and placed in the rooms of the Chemical Society, and that a Perkin Research Fund for the promotion of chemical research should be established, to be administered through the Chemical Society. These recommendations secured a hearty support and an international committee was formed comprising prominent men of science and industry in this and other countries. Over £2,000 has already been received in subscriptions. The portrait has been painted by Mr. A. S. Cope, A.R.A., and the bust executed by Mr. F. W. Pomeroy, A.R.A.

At the meeting at the Royal Institution on July 27th, Professor Meldola, F.R.S., President of the Chemical Society, presided. He opened the proceedings by offering hearty congratulations to the founder of the coal-tar industry, on having lived to witness the consummation of his labours which they were celebrating on the 50th anniversary. In offering him their best congratulations they were glad to be able to add the hearty wish that he might yet be spared for many years to continue those brilliant researches with which his name has become associated during the later period of his life. It was also a matter of congratulation that they were able to refer to the recent mark of distinction which Sir William Perkin had received from the hands of the King. No more appropriate meeting-place could possibly be found anywhere in the British Islands than that hall, the classical home in which Michael Faraday first discovered the hydro-carbon benzene, and there on the table was the original specimen of benzene discovered by Michael Faraday in 1825.

Dr. Emil Fischer presented to Sir William Perkin the Hofmann Medal awarded to him by the Deutsche Chemische Gesellschaft, and Professor A. Haller presented the Lavoisier medal of the Société Chimique

de Paris, and also on behalf of the Société Industrielle de Mulhouse a medal and an address.

Dr. Leo Bakeeland presented a congratulatory address from American chemists, Dr. Paul Friedlander one on behalf of the scientific and technical chemists of Austria, Professor P. van Romburgh one from the chemists of Holland, and Dr. H. Rupe one from the chemists of Switzerland.

Dr. C. Duisberg and Dr. Max Delbrück presented a congratulatory address from the Verein Deutscher Chemiker. Dr. Duisberg, in presenting the address, said that, as manager of one of the largest German colour works, he was personally pleased to present the good wishes of the Verein, seeing that he and his German colleagues were now the gardeners in the large and extensive garden laid out by William Henry Perkin fifty years ago, and as it was their lot to assist in cultivating the young plant planted by him when he discovered the first aniline dye mauve; and furthermore because they in Germany were now gathering the fruits from the large orchard, full of strong and mighty trees, which had grown up to full maturity within the last five decades from the then small and delicate plant. As the heirs to the inventive and technical experiments made by Sir William Perkin in the year 1856, the German colour manufacturing chemists regarded it as their sacred duty to be personally present in the English metropolis most cordially to shake the hand of the esteemed and honoured forerunner in that particular scientific and technical branch, and to express to him their heartiest thanks for his great fundamental achievement. Dr. Duisberg presented a copy bound in mauve-dyed leather of a lecture delivered last June at the general meeting of the Verein held in Nuremburg by the distinguished *doyen* of German scientific chemistry, Adolf von Baeyer, "On Aniline Dye Stuffs." Adolf von Baeyer concluded his lecture with these words, "The key to the knowledge of the nature of aniline colours lies in the basic properties of the carbon atom. The aniline colours which delight the eye have thus attained much more importance to science. The torch which enlightens the path of the explorer was lit by William Henry Perkin." Professor Duisberg added that about 3,500 German chemists, the members of their Verein, were present that day in spirit celebrating with them that unique festival. They sincerely wished the whole coal-tar colour industry, and especially the English organic chemical industry, prosperity and success.

Dr. Caro, on behalf of the Society of German Chemical Manufacturers, Professor Gustav Schultz, on behalf of the Munich Chemical Society, Lord Kelvin, on behalf of the Royal Society, and Professor Meldola, on behalf of the Chemical Society of London, also presented addresses of congratulation.

Dr. Edward Divers, an old schoolfellow of Sir William Perkin, presented a congratulatory address from the Society of Chemical Industry, Professor Percy Frankland one from the Institute of Chemistry, Sir Thomas Wardle one from the Society of Dyers and Colourists, Professor Smithells one from the University of Leeds, and Mr. J. W. Helps one from the Institute of Gas Engineers.

Dr. Schultz presented Sir William Perkin with the doctor's diploma of the Technical Hochschule at Munich.

Congratulatory speeches were also made by Dr. A. Bernthsen, director of the Badische Anilin and Sodafabrik, and by Dr. C. Liebermann.

Sir William Perkin, in reply to all the congratulations received during the day, said:—I am glad that this meeting is taking place in this institution, which I first visited fifty-four years ago, through the kindness of Michael Faraday. I little thought then that in four years' time I should be the fortunate discoverer of the mauve dye, a product which in an indirect way is related to Faraday's scientific work. This fact also connects the industry with the Royal Institution, because it was in this building that Faraday by his researches discovered benzene. In May, 1866, Faraday himself came to the Chemical Society, to hear me give a lecture on "Colouring Matter Derived from Coal Tar," and encourage me by his remarks. I feel the very great honour which is being done me; but what I appreciate most deeply is that this jubilee celebration is an international one, in which nations on both sides of the globe are taking part. I feel that I cannot take all this honour to myself. There are others who deserve much of it, but are no longer with us. I refer to my late father and brother. They joined me when this industry was first started, the firm being known as Perkin and Sons. My father, who was a builder, was much disappointed when I took to chemistry, as he wished me to be an architect, but nevertheless when I obtained the mauve he risked most of the capital he had accumulated by a life of great industry in building and starting the works at Greenford-green. This was indeed a very noble act on his part, for which I have always felt very grateful, for had it not been for this I probably should not have been able to start this industry, as few would have been inclined to undertake the risks connected with the manufacture of such a new and untried product as the mauve dye then was. My father lived about nine years afterwards, and fortunately was rewarded by seeing the undertaking a success. My brother, Mr. T. D. Perkin, who was expected to follow my father's business, helped me in my first small manufacturing operations before the works were commenced. He afterwards conducted the commercial part of the undertaking with great assiduity, and also took a practical part in the works with great success, and we worked together harmoniously for seventeen years, until the works were sold in 1873. Therefore it will be seen to what a great extent the collaboration of my father and brother had to do with the early success of this industry, and consequently I feel that much of the honour so lavishly given me to-day should be accorded to them.

In the evening a complimentary dinner was given to Sir William Perkin, at the Hotel Métropole. Professor Meldola, President of the Chemical Society, occupied the chair, and the company numbered about 200.

JAPAN.

The opinion that Japan will soon be a formidable competitor for Eastern trade will be strengthened by a study of Mr. Crowe's report on the trade of Japan (3675, Annual Series) just issued. In one way or another, directly or indirectly, every factory in the country benefited from the enormous demands for materials required for the war, and as a result the manufacturing capacity has been increased in every direction, profits being largely used for extensions of plant and buildings. This great industrial activity has given makers an experience and confidence in their own ability which will tend to make them far keener and more efficient competitors of the foreign importer than ever before, and this not only in Japan but also in those new markets the development of which should be the sequel of the late war. As Mr. Crowe points out, Japan's industries enjoy the immense advantage of low wages. She is no doubt behind her Western rivals in capital, equipment, and experience, but she is making rapid progress. Foreign capital is now ready to assist her, merchants of various countries are eagerly offering her the latest machinery and the most approved appliances, and she is the more ready to avail herself of the world's experience in that she is not confronted with the necessity, which has to be faced by her rivals, of having to discard previous costly equipment. In the new markets that the war has opened at her door she has in her favour proximity of situation and a closer touch with the people's requirements, while with the additional advantage of political control in Corea, and in the case of Manchuria of temporary military occupation, she is bound to prove a formidable rival in the coming struggle for the new trade. That she has very pressing need for rapid expansion of exports will be understood when it is remembered that since the beginning of the war loans to the face value of £107,000,000 have been issued abroad. Formerly some £900,000 sufficed for the service of the Government's foreign debt. The amount now required for interest alone, including that on the domestic bonds held abroad, cannot be much under £8,000,000, or nearly one quarter of the total value of Japan's exports last year. And to this has to be added the return on the foreign capital now entering Japan through private channels.

It is satisfactory to find that the United Kingdom is more than holding her own in Japan markets. Of the total increase in Japan's imports in 1905 the United Kingdom took £4,122,000 or 34 per cent., its sales to Japan forming 23 per cent. of that country's total imports as compared with 20 per cent. in 1904. This improvement is the more remarkable seeing that Great Britain's chief competitor, America, derived great advantage from her geographical situation which gave her goods the advantage of greater security of transport during the war. Indeed so out of favour was the Suez route for shipments to Japan of materials which might be considered contratraband that a considerable portion of British trade with Japan was done round Cape Horn and even viâ America. Germany has shared in the increase of Japan's imports to the extent of 11 per cent., her sales to Japan, as compared with 1904, exhibiting an advance of 48 per cent., to which locomotives and machinery, iron and steel manufactures, paper, leather, and indigo contributed the most part. How seriously Germany, and in a larger degree the United States, is making headway in the supply of locomotive and railway carriages at the cost of the United Kingdom will be seen from the following Tables which give the value of these imports from the countries named in the years indicated :—

Year.	United Kingdom.	Germany.	United States.
	£	£	£
1902	174,000	11,000	73,c0
1905	173,000	132,000	136,000

The figures for machinery and engines are more than double those of 1904, America taking the first place with an advance of 172 per cent., but the shipments from the United Kingdom show an increase of nearly £400,000. Of the total of £2,134,000, £661,000 is to the credit of turning lathes and other machine tools, £187,000 to that of spinning and weaving machinery; electric motors account for £250,000, and steam boilers and engines for £269,000. It is noticeable that whilst for several years there was a decrease in cotton yarns from the United Kingdom, 1905 shows once more a large increase, the figures being 2,980,033 lbs., valued at £174,000, compared with 716,949 lbs., of £35,000 value. But Mr. Crowe points out that as the native mills, whose production was restricted in consequence of the war, are increasing their number of spindles by some 150,000, this revival of the old trade can only be temporary, and by 1907 the import of foreign-spun yarns will once more become a very small item. Of the yarns imported in 1905 no less than 1,706,000 lbs. were gassed yarns spun from Egyptian cotton, leaving only a small proportion of white yarns spun from American fabric. The United Kingdom is the only country that substantially increased its shipments to Japan of wool and woollens during 1905. The wool imported was, to a large extent, in the form of tops, suitable for blankets and uniforms.

The Japanese imports of indigo in 1905 exceeded those of 1904, the figures of value being £288,000 as against £216,000, but they are still considerably below those of preceding years. In his report for 1904 Mr. Crowe expressed the hope that there might possibly be some revival for the plant indigo of India, in consequence of the large reduction in the duty

payable, now that she benefits by the Conventional tariff, but unfortunately this hope has not been realised. Such plant indigo as was imported came almost entirely from Java, the Indian share of the dye being only a trifle over 1 per cent. as compared with the 16 per cent. from Java, the balance, more than 82 per cent., being artificial indigo from Germany. How rapidly the artificial dye has advanced at the expense of the natural is shown in the following Tables, which give the value of the imports in 1901 and 1905:—

Year.	India. Natural.	Dutch Indies. Natural.	Germany. Artificial.
	£	£	£
1901	146,000	86,000	25,000
1905	3,000	48,000	237,000

By a law promulgated on March 31, 1906, the Japanese Government has been empowered to purchase within a period of ten years the principal private railways, 17 in all. These railways have a total mileage of 2,806 miles. The purchase price is to be calculated as follows:—(1) The construction cost up to the day of purchase, multiplied by 20 times the average rate of profits during the six half-yearly periods commencing with the latter half of 1902 and ending with the first half of 1905. Thus, if construction cost is £100,000, and average profits relative to construction cost have been 10 per cent., then 10 per cent. of £100,000, £10,000, and £10,000 × 20 = £200,000. The amount so arrived at will be handed over to the companies concerned in bonds of equivalent face value bearing 5 per cent. interest, which the companies will distribute among their shareholders. Stores on hand are to be taken over at cost price, and paid for in bonds of equivalent value, taken at their current market price.

THE INDUSTRIES AND COMMERCE OF ARGENTINA.

Agriculture and stock breeding are the chief industries of Argentina, and the wheat of the country figures as an important factor in the world's grain markets. The land under cultivation was, in 1895, nearly 12,000,000 acres. According to an estimate of the Argentine Department of Agriculture this had increased to about 24,000,000 acres in 1904, yet that area constituted less than one-tenth of the total arable land fit for cultivation, this being estimated at about 250,000,000 acres. In addition, there are over 245,000,000 acres which can so far be utilised only for stock breeding, and more than 222,000,000 acres under forests and on mountains containing immense wealth in lumber and minerals. According to the returns of the Argentine Department of Agriculture, the area under cultivation in the agricultural year 1902-3 was 22,000,000 acres. The area under wheat more than trebled from the year 1891 to 1903, under maize more than doubled, and under alfalfa nearly trebled. The production of cereals and linseed occupies about three-fourths of the total area under cultivation, and is concentrated in the central portion of the country comprised within the provinces of Buenos Ayres, Santa Fé, Cordova, Entre Rios, and in the territory of Pampa, which are especially favoured by climatic conditions and proximity to the Atlantic ports. The cultivation of wheat, maize and linseed is constantly increasing, the wheat area alone having reached nearly 13,000,000 acres in 1904-5, and thus exceeded the total area under cultivation of all crops in Argentina in 1895, which was 12,000,000 acres. The linseed area has increased to 3,000,000 acres, and the maize area to 5,250,000 acres in 1903-4. The cultivation of cotton gives great promise, and the northern territories and provinces of Argentina, especially those of El Chaco and Missiones, bid fair to become important sources of the world's cotton supply. In addition to cotton, there are also found indigenous textile plants, known under the names of "chaguar," "caraguata," and "palma caranday," which furnish valuable fibre and cover enormous areas. The production of sugar-cane is also on the increase, and is likewise confined to the northern States. It was originally cultivated in the province of Tucuman, and gradually extended to the provinces of Santiago, Salta, and Jujuy, and is at present being introduced also in Chaco, Formosa, and Missiones. It is already beginning to furnish a surplus for export, which amounted to nearly 50,000 tons in 1901, when the total production exceeded 165,000 tons. There has been a considerable growth in the exports of the principal agricultural products of Argentina of recent years. For example, in 1901 904,000 tons of wheat were exported; in 1905 the quantity had risen to 2,868,281 tons. The exports of maize were 1,222,290 tons in 1901, and 2,222,289 tons in 1905; of linseed, 338,000 tons in the earlier year, and 654,792 tons in the latter. The forests of Argentina abound in rare and valuable species of timber, such as quebracho, jacaranda, lapacho, rosewood, and other dye woods. The export of wood products in 1903 amounted in value to £730,000. The stock-breeding industry is no less important than the cultivation of cereals and other agricultural products. Sheep-breeding is one of the most important branches of the animal industry. The sheep are bred chiefly for their wool, and constitute a very important factor in the wool supply of the world. It is estimated that Argentina provides one-fourth of the wool production of the world. In 1870 the wool product of Argentina amounted to 130,000,000 lbs., in 1891 to 310,000,000 lbs., and in 1900 had grown to about 500,000,000. Three-fourths of the wool produced is of white-faced long woolled sheep, one-fifth of merino, and about five per cent. of black-faced sheep. Sheep are also kept for slaughter, furnishing not only all the mutton used in the country, but also increasing shipments to foreign countries. In 1901 the quantity of frozen mutton exported from Argentina amounted to 63,000 tons, and in 1905 to 79,000 tons.

The figures for frozen beef were respectively 63,000 tons and 78,000 tons. The manufacturing industries of Argentina, which gave employment to about 168,000 people in 1895, the last census year, and represented an investment of nearly £60,000,000 sterling, are chiefly carried on for the supply of domestic wants, only the meat-packing industry furnishing a considerable contribution to the export trade. In 1903, five large freezing establishments were engaged in shipping meat to the United Kingdom, and since then more meat-packing plants have been added. Among the other important industries are flour mills, distilleries, sugar refineries, and wine-making establishments, all of which have been producing a surplus for the export trade. The direction taken by Argentine industry has been in the line of building up those branches of manufacture for which the country is excellently equipped with raw materials. This is true of flonr mills, meat - packing establishments, sugar refineries, breweries, distilleries, &c., all of which not only supply the needs of the country, but furnish a considerable surplus for export. There are also industries with a considerable number of people employed, and representing large investments of capital, which are satisfying, to an increasing extent, the needs of the people for clothing, footwear, furniture and household goods, metallic products, chemicals, &c. Electric lighting and gas plants are also increasing in number and are largely in foreign hands. All this has had its effect on the character of the export trade. A comparison of the figures of the imports and exports of Argentina in the last fifteen years shows that, while in 1891 the exports exceeded the imports by nearly £8,000,000 sterling, in 1905 the exports exceeded the imports by more than £24,000,000. During this period the imports trebled, increasing from nearly £14,000,000 to £40,000,000, while the exports increased from nearly £21,000,000 to £65,000,000. The United Kingdom, which enjoys the largest share of the import trade, sent into Argentina in 1905 merchandise worth over £13,000,000 sterling, or about one-third of the total. Next in order of importance is Germany, the imports from which in the same year exceeded £5,000,000, closely followed by the United States, from which country Argentina imported commodities worth nearly £6,000,000. The only other countries of importance in the import trade of Argentina are France with over £4,000,000, and Italy also with a little over £4,000,000. Until a few years ago the imports from the United Kingdom were greater than those from the United States, Germany, and France combined. The principal imports of Argentina are coal, textiles and wearing apparel, various manufactures of iron and steel, pottery, glass, food products, manufactures of wood, beverages, chemicals, minerals and oils, paper, and tobacco. As regards exports, the United Kingdom again figures as the most important customer of Argentina, being credited in the Argentine accounts with about 9,000,000 pounds' worth of Argentina's exports in 1905, but as a matter of fact the exports to the United Kingdom are very much larger since a large part of the cereals shipped from Argentina to St. Vincent and Las Palmas "for orders" usually finds its way to the United Kingdom. In the "Annual Statement of the Trade of the United Kingdom," the imports into this country from Argentina in 1905 amounted in value to over £25,000,000 sterling, as compared with £12,000,000 in 1901. The next country in the order of importance of Argentina's customers, according to the Argentine figures, is France, followed by Germany and Belgium. It is probable, however, that a very large part of the exports to Belgium find their way ultimately to Germany, which would in that case rank second in the order of importance, leaving France behind. The principal exports of Argentina are cereals, linseed, animal products, and dyewoods. The annual exports of Argentina have been regularly in excess of the imports since 1894. Previous to that the imports usually exceeded the exports. This may be explained by the fact that Argentina is, to a greater and greater extent, satisfying the immediate wants of its people, that its rapidly increasing population is furnishing a larger and larger surplus of agricultural products in excess of their own immediate needs; that in the earlier years a considerable part of the imports represented investment of foreign capital, in railways and manufacturing enterprises which reached the country in the form of steel rails, railway rolling stock, machinery and other equipment required by railways and industrial plants which were almost entirely imported from the countries which furnished the capital.

FOOD SUPPLIES.

The Board of Agriculture and Fisheries has just issued in complete form the agricultural statistics for 1905. Some of the information in this volume has been already separately issued immediately on the figures of each section becoming available, but much information will be found in the present volume which cannot be furnished until some time after the close of the calendar year, while the latest available statistics of the agriculture of British possessions and of foreign countries are also furnished. The annual returns for 1905 complete a series of forty years' official records, and Major Craigie traces the gradual development of statistical data respecting the agricultural position of this country. It was in 1866, and at the instance of the late Sir James Caird, that the House of Commons passed the formal resolution which led to the establishment of the system of annual statistics for Great Britain which were first instituted by the Board of Trade in that year. These remained in the hands of that department until 1883, when they passed to the Agricultural Committee of the Privy Council, and to the Board of Agriculture on its formation in 1889. The bulk of the volume testifies to the increase in the extent of the information pro-

vided. Comparing the volume now submitted with that issued in 1867, it will be found that the present issue contains 160 tables against only 10 at the earlier date, and 368 pages of explanatory matter as against 53, while in addition to the single annual volume seven preliminary issues of separate sections of the returns are now published, so as to place the earliest possible information at the disposal of the farmers of the country.

If comparison is made between, say, 1871-5, a period anterior to the advent of the serious foreign competition which in lowering the current prices of grain to the native cultivator led in a greater or less degree to the curtailment of arable farming in this country, with the present time, it will be found that there is no decrease, but rather a perceptible increase in the land returned as "cultivated," that is under all crops and grass, but taking the arable acreage alone, there has been a large shrinkage. Nine-tenths of the loss of this acreage has occurred in England, where there are 2,840,000 acres less land under the plough. In Wales there are 260,000 acres less, but in Scotland apparently no more than 50,000 acres. The Welsh ratio of decline is, however, as much as 24 per cent., while that of England is 21 per cent. The loss of arable acreage in England has been by no means uniform. In the South-Eastern and East Midland counties, the decline represents a round million acres, and extends to 30 per cent. of the land formerly under the plough, in the east and north-eastern division, it hardly reaches a third of this rate. The number of cattle maintained shows no diminution, a subject of congratulation in view of the importance of the meat supply of a population which not only increases steadily in numbers, but also, in proportion to its improving economic conditions, in capacity for meat consumption. As compared with 1896, there are 25 sheep less on each 1,000 acres than in 1899, but this is more than counterbalanced by an increase of nine cattle.

It would seem that there is a slight but continuous reduction in the extent of owner-farmed land, and it varies widely in different counties. In 1888, when the first attempt was made to utilise the agricultural returns to give some indication of the current prevalence of farming by owners in Great Britain, the owner-farmed land was given as 15 per cent., and it ranged from 35·3 per cent. in Surrey, and 32 per cent. in Berkshire, to only 8 per cent. in Cheshire, 8·6 per cent. in Lancashire, and 8·7 per cent. in the North Riding of Yorks. The average has fallen from 15·9 per cent. in 1888 to 13 per cent. in 1905, and nearly everywhere the county average has declined. The group of counties, nevertheless—Surrey, Sussex, Berkshire, and Hampshire—which in 1888 showed the highest percentage of owner-farmed holdings, 25 to 35 per cent., still stands high in this respect, and Surrey has now even a higher percentage than before. It may be noted that in 1895, when low grain prices were very conspicuous, the ratio of owner-farmed land was much the greatest in the larger farms. The number of very large farms is on the decrease, but there is a considerable increase in holdings over 50 acres and under 300 acres.

Turning to agricultural imports, the number of cattle imported during 1905 was 565,139, the largest number since 1898, when it was 569,066; but last year there was a great falling off in the number of sheep imported, 183,084 as against 382,240 in 1904, and 663,747 in 1898. Of pigs there was a consignment of 150 from Canada, and this represents the first arrival of live pigs in the United Kingdom since 1898. The total of dead meat shows an increase of over a million cwt. as compared with 1904 (18,023,429 cwt. as against 16,983,788 cwt.), and is the highest aggregate import received since 1901. In the interval beef, and to a lesser extent mutton, have largely though not entirely, replaced the decline of over 1,100,000 cwts. in the imports of pig meat. The increased amount of fresh beef came from Argentina, which now sends to the United Kingdom more than is received from the United States. Over 50,000 cwts. of fresh mutton were received from Uruguay, whence nothing had come in the preceding year, while the Australian quota was three times that of 1904. The decline in pig meat was mainly in fresh pork from Holland, and bacon from Denmark.

An interesting table of the volume under consideration is that which shows the very different uses made of their arable land by different European centres. Taking a thousand acres of arable land in each country and comparing it with a like surface in other countries, it will be found that the relative space of arable land occupied by wheat is largest in Hungary (261) and smallest in Denmark (5); of rye largest in Germany (233) and smallest in the United Kingdom (4); of barley largest in Denmark (109) and smallest in France (27); of oats largest in the United Kingdom (220) and smallest in Hungary (77); of potatoes largest in Holland (170) and smallest in Denmark (21); of roots largest in Belgium (200) and smallest in Hungary (18); of fallow largest in France (131) and smallest in Holland (7). The pre-eminence of British agriculture in oats, and its relatively large area of roots, and the small surface left in bare fallow are matters of note. Against these are to be set the large German crops of rye and potatoes, and the large area of wheat in France, but the position there is not really very different from that of Germany in the proportion of bread corn average if rye be added in both cases, making 302 cases in every 1,000 in the one case to 306 in the other, Hungary exceeding both with 340 acres. Denmark has the least proportion in wheat and potatoes and a considerable portion in fallow. The figures illustrate how similar the position of the German Empire, with its rapidly increasing urban population, is becoming to that of the United Kingdom. With an absolute present population of 60 millions as against 45 millions in 1880, the growth of 33 per cent. in persons has not led to any very material increase in the area devoted to bread corn. The aggregate acreage of wheat and

rye was about 19,000,000 acres twenty-five years ago, and it is still under 20,000,000 acres, an increase of between 3 and 4 per cent. The German imports of wheat now represent from one-third to two-fifths of her requirements for cónsumption, but the large rye crop still nearly supplies all the demands of the population on this cereal. For each 1,000 inhabitants the German Empire has less than 90 acres of wheat against 105 in 1878, and 262 acres of rye against 318 at the earlier date. But there has been a large increase in the area under potatoes since 1880, as from 6,800,000 acres to 8,200,000 acres.

The British Empire stands third in the list of wheat producers, the United States being first with 84,000,000 quarters, Russia next with 83,000,000 quarters, and the British Empire third with 65,000,000 quarters. In its animal wealth the British Empire distances all its competitors as it does in its human population. Including buffaloes the British flag covers a herd of 120,000,000 head of cattle, the United States being next with 67,000,000, and Russia third with 45,000,000. In sheep the British imperial total is 157,000,000, one-half being in the Australasian colonies, the Russian estimate is 65,000,000, and that of the United States 45,000,000 only. The latter figures are very remarkable since they represent a return to the number of the flocks in the United States reported a quarter of a century ago. The widespread loss of the flocks of Continental Europe have left the United Kingdom in a position far better than any other country in the number of sheep maintained in its territory. The next largest number is to be found in Servia, where, indeed, the sheep are more numerous than the inhabitants, but only 253 to the 1,000 acres, as against the 374 of the United Kingdom.

GERMAN TRADE.

In his report upon the German trade outlook, Mr. Consul-General Oppenheimer refers to the process of industrial concentration which continues to be a characteristic of German industry. The number of syndicates is still on the increase, and as a result individual enterprises have a tendency to unite, wherever possible, the whole process of manufacture in their own hands. This tendency is most pronounced in the iron industry. The large iron works continue in their endeavours to combine at least the production of raw iron, and the production of half finished goods, if not of finished goods also. For this purpose they acquire their own coal mines, and their own coke works. This gives them the economic advantage of freedom from the rule of the syndicates, whilst securing for themselves through their sale of half-finished and finished goods the syndicate's profit in the various stages. They save the contribution to the coal syndicate, to the raw iron syndicate, and possibly to the "Stahlwerks-Verband." As the natural result of syndication the prices of finished articles has been run up. The iron industry more than any other believes in concentration for the future success of its manufacture, and hopes thereby to strengthen its competitive power in the world's market. But this development naturally affects those enterprises which are not officially strong enough to participate in the general movement, and the loudest outcries against this "sign of the times," come from within the iron industry, and are raised not only by the rolling mills, but also by the machine industries, and by the manufacturers of other branches.

The production of raw iron in Germany shows remarkable increase in recent years. In 1896 it amounted to 6,372,575 tons; in 1905 it had increased to 10,987,623 tons. The condition of the iron and machine production generally corresponded to the increased production of raw iron, and the present reports concerning the iron and steel markets are quite exceptionally favourable. It is a noteworthy fact in proof of the progress made by the German iron industry that the number of the workmen has not risen in proportion to the increase of the production. In 1895 the production amounted to 5,500,000 tons, and the workmen numbered 24,059; in 1904 the production had risen to 10,000,000 tons, and the number of the workmen only to 35,284. In 1895 the quantity produced per head of workmen employed amounted to 227 tons; in 1904 it had risen to 283 tons, that is to say, the number of workmen increased during the decade by 47 per cent., but the quantity produced increased by 84 per cent.

The cloud in the German industrial outlook would seem to be what is designated as the "price struggle," which embraces well nigh all branches of manufacture. The working classes are suffering from the increased cost of food stuffs, which is an unavoidable consequence of the Protectionist agrarian policy. It is doubtful whether German agriculture will ever again be able to supply a sufficient quantity of meat for the rapidly increasing population. Nor is it only the price of meat that has gone up upon insufficient home production, and the practical closing of the frontier against the importation of foreign cattle. This increased price of meat has led to an increase in the price of other food stuffs, especially butter, fat, poultry, fish, vegetables, &c. Necessarily the working classes are most affected by the rise in prices, and have been led to agitate and stand out for increased wages and better conditions of labour. In as far as the strikes brought the workmen the concessions they asked a considerable part of the success has been neutralised by the increased cost of food. It is held by many German authorities that a permanent increase of cost of production in German manufacture will be the result of the recent protective legislation, and that the Protectionist policy may thus undermine Germany's position in the world's market even if it has to a great extent safe guarded her home market.

Mr. Oppenheimer has some interesting remarks upon the German view of the effect of war upon trade, as illustrated by the struggles of the last thirty years. Immediately after peace in South Africa the com-

mercial world in Germany hoped for an increased export to South Africa, a hope which was disappointed, because the wounds which the war had inflicted required more time to heal than had been anticipated. Again, after the conclusion of the peace between Russia and Japan hopes were entertained that the end of the war would lend a fresh impetus to trade, but once more it was proved that the after effects of a war injure rather than benefit economic life on the whole. To a certain extent industry must benefit through the call for war supplies, but the war itself plays havoc not only with commercial commodities but also with finances. Thus Russia requires imports as much as ever, yet the economic depression which is an after effect of the war, and the unsettled state of affairs, is likely for years to come to prevent a genuine commercial revival. Hopes have also been abandoned in Germany that demands from Japan will to any extent animate German commerce. On the contrary, there are fears that Japan's rapid development will place a dangerous competitor in the markets of Eastern Asia. It is true that after the war of 1871 an unprecedented economic resuscitation took place in Germany, but this, Mr. Oppenheimer contends, was based upon and fostered by the French war indemnity of 5,000,000,000 francs. The more recent treaties of peace provided no war indemnities, and the more modern experiences tend to teach the lesson that every war is a calamity not only for those directly, but also for those indirectly concerned. The further a country is commercially developed the greater becomes its loss from any breach of the peace, and it may therefore be assumed that the Germans, who are a nation shrewd in trade and manufacture, are sincere in their expressions of a desire for the maintenance of peace.

LOURENCO MARQUES.

The report of Major Baldwin, Consul-General at Lourenço Marques (3666, Annual Series) shows how greatly Delagoa Bay depends upon the Transvaal for such business as it does, and the large sums brought back to it by Kaffirs who have been at work in the Transvaal mines. The commercial state of the district is bad; there are no manufactures, and the exports of raw material are trifling in amount and value. Port and town are as much, if not more, dependent than in former years upon the transit trade with the Transvaal. From the point of view of the Treasury, whose revenue is swollen by means of harbour and dock dues, customs charges, and railways receipts, the situation is satisfactory enough, but the same cannot be said either for the merchant or the consumer, who in many ways is indirectly affected by dependence upon the Transvaal transit trade. The statistics of this transit trade show an increase in declared value of a little over 40 per cent. as compared with 1904, but the growing popularity of the port for the handling of the Transvaal trade may be gauged by the commercial tonnage which passed through the various South African ports during 1904 and 1905. In the earlier year the percentage passing through Cape Colony ports was 16·2, in 1905, 12; through Durban 40·8 in 1904, 36·5 in 1905; through Lourenço Marques, 43 per cent. in 1904, and 51·5 in 1905, while the total amount of this class of traffic was 21·6 per cent. larger in 1904 than 1905. The proportion of the whole passing through the Cape Colony ports of Cape Town, Port Elizabeth, and East London decreased by 10·7 per cent.; the proportion passing through Durban increased by 8·6 per cent.; while that passing through Lourenço Marques increased 45·8 per cent. As the harbour and landing facilities increase, so doubtless will the volume of Transvaal traffic dealt with at this port, and in Major Baldwin's opinion, it can only be a matter of a comparatively short time when Lourenco Marques, at the expense of the other South African ports, will handle 75 or 80 per cent. of the Transvaal oversea imports. It is satisfactory to note the increase in the share of the United Kingdom and of British Possessions in the import trade. In that portion of the transit trade which passes through Lourenço Marques the share of the United Kingdom has increased by over 25 per cent., and represents 55 per cent. of the total, a proportion that would be considerably larger, the Consul-General thinks, were it not for the practical monopoly possessed by a German line of steamers of the trade by the Suez Canal and the East Coast of Africa.

Major Baldwin gives some interesting figures as to the value of the Kaffir trade and the large proportion of their earnings spent by the Kaffirs in wine. The districts which are supplied, either wholly or in part, through the port of Lourenço Marques are those of Inhambane, Gaza, and Lourenço Marques. These districts alone supplied over 38,000 native labourers to the Transvaal during last year, and the number of them actually known to be employed in that colony at the end of 1905 was over 56,000. In last year's report, from a calculation based on the wages earned by these natives, it was deduced that they brought back with them every year into Portuguese territory from the Transvaal an amount of from £660,000 to £880,000. As local manufacturers do not exist, and as practically each family grows more of the staple food of the country than is required for its own consumption, it follows that this sum must be expended in the purchase of oversea goods, and a consideration of the imports for the Kaffir market bears out this conclusion. If the average selling price of the wine imported during 1905 be taken into consideration, after making a liberal allowance for the consumption in towns, the amount of money spent by natives in drink during that year cannot have been much under £500,000. The selling price of the other imports for

the Kaffir market during 1905 is at a moderate estimate £350,000, and the amount received in native taxes from the three districts in question was, for approximately the same period, £147,000 in hut taxes, and about £47,000 in immigration fees. The total disbursements amount therefore to over 1,000,000 a year, of which nearly half is spent on wine.

GREEK LACE.

There are two hundred and twenty girls at work in the Royal School of Needlework and Laces at Athens, and there are branch schools under the same direction at Aegina, Corinth, Salassi, Koropi, Kerate, and Ithaca; at Monastir and Salonica in Thessaly, and a large school in Crete. In all, about one thousand girls are given employment. The history of this industry is, according to the American Consul at Athens, briefly as follows:—After the war between Greece and Turkey, about eight years ago, Athens was filled with destitute Thessalian refugees. The women, scarcely without exception, knew how to weave on hand looms, as the country people of Greece largely make their own cloths. Lady Egerton, wife of the British Minister, successfully undertook to set them to work, and their cottons found a ready sale in England. This benevolent lady next noticed the embroidery on the skirts of the peasant women's dresses, and on the sleeves of their jackets, and she was convinced that they possessed a real talent for embroidery. Thus was started the present Royal School of Needlework. By the time the Thessalians were ready to return to their homes, a nucleus of Athenian girls had become interested in the work, and had taken it up. The building in which the School at Athens is now housed, was given by the King, who is a constant benefactor of this benevolent enterprise. The ground on which the house was built, was given by a Greek lady. The Princess Helene is the patroness of the schools, and gives them her personal supervision, devoting several mornings of each week to this work. Greek embroidery is distinct from that of any other country in its superior quality, and in the beauty of the designs. These latter have a certain historic interest, and are derived not only from the patterns in use among islanders, showing the successive Byzantine, Venetian, and Turkish influences, but also from the mural decorations in the ancient Mycenæan and Cretan palaces, and from the paintings on vases. The consul says that he has been shown various samples of Greek embroidery and describes them as follows:—One is a Cretan design showing Byzantine influence. The Byzantine double eagles can be distinctly seen in the margin. It is worked out in many colours. Another is an island design showing Venetian influence, taken from an altar cloth. A third is from a gown found on a classical vase, and is therefore an exact reproduction of ancient embroidery. A fourth is a specimen of the sort made at one time extensively by the Venetians. Old lace of this kind is rare and expensive. A fifth is an island design with the so-called rose-spray effect. It was copied from a handkerchief worn about the head by the women of the island of the Turkish coast, and is now made into a small cushion. A sixth is from the ceiling of the prehistoric palace at Orchomenos, and was probably in blue and gold originally. It is now made in straw colour, blue, and red. A seventh is an island design showing Turkish influence. Last year the sales of the schools amounted to something over £4,000, taken largely in London and Paris. Among those who have given orders are the Queens of England and Norway, the Grand Duchess Vladimir, and many Americans.

MINERAL SPRINGS AND MINING OPERATIONS IN AUSTRIA.

The Austrian Government has recently appointed a Commission to investigate the relation between mining and mineral springs. It is notable that wherever mineral springs exist, or bathing resorts have been established in Austria they are surrounded by hills, in the valleys of which these bathing places are situated. The American Consul at Carlsbad, says that Teplitz, in his consular district, where there are hot mineral springs, lies in the centre of the Bohemian coal-mining trade, and close to Carlsbad are the famous Kaolin or clay mines, from which 3,0co railway truck loads of clay are obtained annually, and from these mines the necessary material for the supply required by the Austrian and German factories is obtained. One of the most serious questions confronting those interested in the mineral springs of Austria for many years past, is, first, in what way does mining endanger the flow of these springs, and secondly in what way can the best protection for the sources of these waters be obtained. The mineral springs in Austria, which are mostly the property of corporations or private individuals, are highly valued by the Austro-Hungarian Government, while on the other hand the coal and clay mines provide work for thousands of men, and in consequence of the abundant and cheap supply of coal, flourishing manufacturing towns have grown up along the lines of these mining districts, from which the Empire derives a considerable income. Up to the year 1879 the inhabitants of Austria never seriously investigated the question of how far mining, and mineral springs, influence each other, but in that year it was discovered, that the hot springs of the town of Teplitz, which had been known to exist since the year 762, or 1,117 years continuously, had suddenly disappeared, and two hours later, reports reached the town that water had broken into three coal mines about 15 miles distant from Teplitz and 21 miners were drowned. When in addition it was discovered that the waters in the mines were 40° warm, it was clear that it must have been the same water that disap-

peared from the springs at Teplitz. During the past 27 years, the municipalities and proprietors of mineral springs have been petitioning the Austrian Government and Parliament, to establish laws for the protection of mineral springs against the effect of mining, and the Austrian Government recently appointed a commission of experts, who will thoroughly examine the existing laws and conditions, and in all probability establish new laws and regulations.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in May, 1906:—

New Charts.—3568 — North sea, Germany:—Lister deep. 3524—Norway:—Tiötta to Dönna (outer approaches), including Husvær and Gaasvær fiords. 3529—Norway:—Tiötta to Dönna (inner fiords), including Vefsin and Leir fiords. 3556—Norway:—Lyngvær to Varholmen. 2117—Germany:—Kiel bay. 2478—Africa west coast; Manna river to Junk river; plans:—Cape Mount bay; Monrovia bay. 2455—Bay of Bengal, Andaman islands:—Stewart sound. 1767—China, east coast:—Approaches to Amoy harbour. 3554—China, north-east coast:—Tau Tsui head to Shitau bay. 2815—Japan, Nagasaki harbour; plan:—Approach to Mitsubishi dockyard. 627—Africa, west coast; St. Paul de Loanda to Great Fish bay; plan added:—Farta bay. 2284—Plans of anchorages on the west coast of Sumatra; new plan:—Sinabang bay. 1239—New Guinea, Hall sound; Vari Vari anchorage; plan added:—Fyfe bay.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—1872—North sea:—Calais to the river Schelde entrance. 1128—Sardinia:—Ports in Sardinia; ports Conte and Alghero; port Torres; gulf of Oristano; Arbatax road. 3119—Africa, North coast:—Alexandria harbour. 566—Iceland:—Eastern portion. 2978—Iceland:—Sigle fiord to Niardvig. 19—South America, east coast:—Santos harbour. 887—South America, Magellan strait:—English, Crooked, Long and Sea reaches. 631—Chile:—Smyth channel from South entrance to Fortune bay. 704—Madagascar:—Nosi Shaba to Moramba bay including Narendri bay. 2377—Philippine islands:—Between St. Bernadino and Mindoro straits. 2987—Philippine islands—San Pedro bay to Libukan islands, including Juanico strait. 2454—Philippine islands:—Northern portion of the island of Luzon, with Bashi and Balintang channels. 1477—New Guinea:—Jomard island to Yeina Island, including Misima, D boyne, and Renard islands. 2528—New Zealand; Sheet IV.; Poverty bay to cape Palliser.

These charts are issued by Mr. J. D. Potter, 145, Minories.

ARTS AND CRAFTS.

National Competition.—Every year just when people are going out of town, an exhibition opens at South Kensington to which few visitors but students and art teachers seem to find their way. Year after year the most important works executed in the schools of art throughout the kingdom are sent up to London to compete in the national competition, and the successful designs are exhibited in some part of the buildings belonging to the Victoria and Albert Museum. It is, of course, easy enough to pick holes in the work of the Board of Education, and to talk airily about red tape; but whatever the shortcomings of the Board, whatever the evils of the examination system as a whole, the fact remains that, for good or for ill, practically all the design teaching in the British Isles which is conducted in schools and classes, and not given casually in the workshop, is under its control. The works exhibited come from England, Scotland, Ireland, and Wales, and they represent the results of the design teaching of the country as a whole. Thus, they not only show the best work which the schools are producing, but also the direction in which the students generally are working, which branches of design are becoming prominent and which being neglected, which subjects are popular and which unpopular, and what connection exists between the schools and the local industries in various places. It is not too much to say that the exhibits at the national competition do not merely reflect the existing condition of teaching in the schools, but, what is more important, demonstrate very clearly the direction in which that teaching is tending, and serve as a sort of index both of the style of the decorative art of the immediate future and of its relation to the industry and commerce of the country. In view of this, it is surprising how little interest and attention the exhibition seems to arouse outside the circle of those immediately interested in the results of the competition. Two facts are strikingly brought home to the careful observer by this year's show,—the decline, one might almost say the death, of the so-called *art nouveau* and the capture of the schools as a whole by the Arts and Crafts theory of design.

The Decline of the "Art Nouveau."—Now, the decline of the *art nouveau* is real. South Kensington is generally called, and called with a fair show of reason, conservative, but two or three years ago, even amongst the designs which gained high awards, the swirl at that time considered up-to-date reigned supreme; to-day it is only met with here and there in the less distinguished work, while the "Glasgow rose" and the "honesty tree" have returned to the obscurity from whence they came. The odd thing is that, while it is easy to see that the *art nouveau* has gone, it is rather difficult to say what has taken its place. The students who were trained under its influence have forsaken it, but they

are for the most part ignorant of historic art, they have little or no tradition to which to return. The result is a collection of designs, interesting or uninteresting as the case may be, but, on the whole, singularly styleless. The designers appear to have returned to more or less natural flower forms, and finding these not sufficiently to their purpose have introduced some fresh element to eke them out, most commonly a bird. They seem to have no idea of treatment, or of the introduction of simple decorative forms. There is a veritable aviary in the exhibition. Not only do we find designs in which birds are the most pronounced feature, but over and over again, forms which did not at first sight explain themselves turn out to be birds of one kind or another. This flight of birds will doubtless soon pass. Their introduction is obviously, in many cases, a kind of makeshift, but it will be interesting to see whether next year the students will have turned towards naturalism or to historic style.

The Schools and the Arts and Crafts Theory. —The capture of the schools by what we may call the Arts and Crafts theory of design, has been going on slowly for some years past. It has this year reached a stage which leaves no room for doubt. With very few exceptions the cleverest students have devoted themselves to designing for something which they can themselves carry out rather than for some process of manufacture. And this is not merely the case in the smaller and less commercial towns, but also in the great centres of industry, notably London and Birmingham. Some years ago the design exhibits consisted almost entirely of patterns to be reproduced in printed or woven fabrics, wallpapers, &c. Occasionally some more venturesome student would send up a bit of embroidery or a stencilled hanging, but that was quite the exception. To-day it is practically the rule—and not only are nearly all the designs for embroidery, stencilling, and metalwork accompanied by executed specimens, but a certain proportion of those for lace, pottery, tiles, &c. Of course, in a way, this means an increase in practicality. If a student executes his own design or gets it executed before national competition, he finds out quite definitely and unmistakeably what can and what cannot be done in the material and by the process for which he is designing. He will not design a stencil with impossible ties or describe embroidery as satin stitch when it is obviously suitable for *appliqué*. But the revolution, like most revolutions, has its drawbacks. The theory, to begin with, was all on the side of practicality. The design of the students was "academic," it must be brought into touch with actual execution that it might become more workmanlike. But from that starting point has come something widely different. The art student apparently is not by nature a practical mortal, and he naturally enjoys trying his hand at various crafts. Moreover, it is, of course, not always easy or even possible for students to get their designs for cotton prints, wallpapers, &c., carried out in the material. Whatever the cause, the result of this striving after practical work has been in a measure unpractical. It has diverted the attention of the students from the great manufactures of the country, and has led them to devote their energies to designing for embroidery, stencilling, enamel, jewellery, and so forth, which they could either execute themselves, or easily get other people to carry out for them. The designs for carpets, printed cotton, printed and woven silk, wall-papers, and manufacture generally, which used to form the backbone of the exhibition, are now of quite secondary importance, and, as a rule, compare neither for quantity nor for quality (as the examiners' awards show) with those of which specimens can be more readily made. Moreover, they certainly cannot be said to make up for their other deficiencies by their better understanding of the conditions to which they should be adapted.

Design and Industry. — Another remarkable fact is that, although the greater number of the designs for pottery come from Burslem and Hanley and Nottingham and Devonshire provide some of the best lace designs, it is rather startling to find that the works sent in from many manufacturing centres show little or no connection with the principal local industry. The cotton prints come mainly from London and Leeds, not from Manchester, and the best carpet design from Battersea. Furniture begins to form a feature in the exhibition. That shown includes two chairs of a very substantial kind as well as a cabinet. It will be difficult to find space to show the works if it becomes the fashion to send up large pieces of furniture, and it would be well-nigh impossible to show more than sketches for interior decoration, though the desire to send in executed specimens of the work might lead students to submit them. Speaking generally, the executed specimens improve in workmanship year by year, and this is especially the case with the metalwork and the embroidery. In the case of the last craft there have for some years past been decided signs that a lively interest is being taken in the subject by several schools. Some years ago Plymouth made a new departure with an excellent piece of pictorial work executed almost entirely in *appliqué* of linen on linen. The direction taken this year, with the exception of two interesting pieces of church embroidery which gain respectively gold and silver medals, is largely that of embroidery applied to dress decoration. There are several fronts and other dress trimmings which are tasteful in design and quite good enough in execution. This is a use to which simple embroidery can be put with admirable appropriateness. Wood inlay is another craft which begins this year to be satisfactorily represented, while leather work, long the fashion, has all but disappeared from the list of exhibits. It is curious how the interest in these minor crafts seems to fluctuate from year to year.

GENERAL NOTES.

Madagascar.—British trade in Madagascar is not on the increase so far as imports are concerned. They are insignificant, and Mr. Consul Porter, in reporting upon the island (3671, Annual Series), says the prospects of improvement are not encouraging. The total value of the imports from the United Kingdom in 1905 was only £11,437 as compared with £35,856 in 1901. Exports show an increase of 23 per cent. as compared with 1904, but they only amounted in 1905 to £44,915. A year or two ago it was believed that valuable gold-bearing reefs had been discovered in the island, and its gold mines became the theme of much discussion in Johannesburg. Several syndicates were formed to acquire properties in the island, and in July last an important party of Rand mining men, representing influential interests in the Transvaal, came to Madagascar to report on the value of the properties that were being acquired. These reports, however, were very discouraging, and showed that the experts from South Africa had been very unfavourably impressed with the mineral potentialities of the island. Meanwhile the French Colonial Minister would seem to have over estimated the importance of the mineral wealth that was reported as having been discovered in the island, and impressed by the possible influence of such discoveries on the immediate future of the colony, suspended the then existing mining law, and prohibited, until further notice, the registration of any claims whatever. This drastic measure was somewhat modified later on by a decree authorising the provisional registration of claims and of applications for mining permits, such registration however not conferring the right to work claims so registered, but merely establishing the order of priority in which applications would eventually be considered after promulgation of a further mining decree then in course of preparation. However, decrees are not of much importance unless there are profitable reefs to be worked, and these have not yet been discovered.

Sugar Growing in Italy.—It was in 1836, when Count Cavour was Prime Minister of Sardinia, that the first attempt was made to grow sugar in Piedmont, and the experiment failed. In 1844 other experiments were made at Sarno, near Naples, with rather better success. But it was not until 1887 that the sugar industry showed signs of taking a firm hold in Italy. And as late as 1895 there were only three sugar mills, producing something under 27,000 quintals, in the country. It is during the last ten years that the cultivation of beet for sugar purposes has become an important industry. It now consists of 33 mills and five refineries, and gives employment to some 12,000 hands during the season, which lasts about three months, and permanent employment besides to about 5,000 men as workmen, clerks, and general *employés*. The mills and refineries belong to 18 different companies, with a paid-up capital of £4,328,000, and a turnover of more than £20,000,000. The ground covered by the roots amounts to about 100,000 acres, and employs some 12,000 labourers, yielding roughly from £8 to £13 per acre, besides the by-products for feeding cattle, and producing manure. Mr. Consul-General Rolfe, from whose report (3679, Annual Series) these particulars are taken, says that the consumption of sugar in Italy is calculated to amount to 6½ lbs. per head of population per annum, which is much less than the consumption among northern nations. The fiscal laws of Italy stand in the way of utilising the roots to the best advantage, as molasses and alcohol, which might be obtained from them as well as sugar, cannot in existing circumstances be produced at a profit.

Oriental Tobacco in Italy.—Reference has already been made in the *Journal* to the steps taken by the Italian Government to extend the cultivation of Oriental qualities of tobacco in Italy in the Lecce Province, where soil, temperature, and other local circumstances favour its cultivation in an exceptional degree. In his report on the trade of the province just issued, Mr. Consul Cocoto (3672, Annual Series) says that special concessions have now been made by the Tobacco Administration to persons and groups of persons undertaking to cultivate, prepare, and export Oriental qualities of tobacco. The Tobacco Administration offered to provide seed and such technical advice as local circumstances might require, with the result that during 1905, in addition to 33,000,000 plants of various grades of Oriental tobacco cultivated for account of the Italian tobacco monopoly, seven land owners, or groups, collectively applied for, and obtained permission to cultivate 460 acres during the present year, this being a very large increase on the quantity raised under similar circumstances during 1905. Senor Candioto, the director of the Tobacco Department, considers there is a brilliant future for Oriental tobacco cultivation in the province, and hopes that groups of capitalists will be formed to cultivate larger tracts of land than any individual would consider himself capable of handling.

Non-Official Liquidators.—Under the new Winding-up Rules made by the Lord Chancellor in 1903, it is provided that if the Board of Trade is of opinion that the remuneration of a liquidator, as fixed by the Committee of Inspection, is unnecessarily large, the Board of Trade may apply to the Court, and thereupon the Court will fix the amount of the remuneration of the liquidator. In his report for 1905, just issued, the Comptroller of the Companies Department of the Board of Trade says that since the passing of this rule, liquidators have from time to time been informed that the Board of Trade propose to apply to the Court in accordance with the rule to fix the amount of the remuneration. In each case, however, a voluntary reduction on the part of the liquidator has obviated the necessity or any reference to the Court.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The results of the Intermediate Examinations (Stage II.) were published yesterday (Thursday), and copies for distribution to Candidates will be sent to all Centres next week. The results of the Elementary Examinations (Stage I.) will be published at the end of this month, or early in September.

PETROLEUM IN JAPAN.

By I. A. Stigand, B.A., F.G.S.

Petroleum was discovered in Japan at a very early date, and the collection of it for use was commenced in early times. Natural outcrops of petroleum occur in several places, and in many parts they are abundant. Natural gas is also found, and in some places, *e.g.*, near Sanjo (Echigo), is utilised for lighting purposes. The production of petroleum is practically limited to the province of Echigo, although small quantities are obtained in the province of Ugo—near Akita and Hirayama, and in the province of Shinano—in the vicinity of Nagano; while in the province of Totomi, on the East coast, there is a small oilfield (the oilfield of Sugegaya) near the town of Sugara, which produces the most oil after Echigo. Also some petroleum is collected on a small scale and by primitive methods in Hokkaido, where there are many surface indications. But the statistics show that by far the greater amount of petroleum is produced in Echigo; *e.g.*, in 1898 the production was as follows in the different provinces:—

Echigo	318,622 koku.
Totomi	2,783 ,,
Other provinces	1,000 ,,
	322,405 ,,

In 1900—

Echigo	833,766 koku.
Totomi	2,715 ,,
Other provinces	17 ,,
	836,498 ,,

A koku is equal to 180·3907 litres, or 39·7033 gallons.

Formerly the oil was obtained by means of dug wells, and even now these wells are to a great extent in use. The industry did not reach any great importance until the discovery of the Higashiyama oilfield in 1888, and at this time bored wells were introduced and American principles adopted.

On the successful opening of the oilfields of Kamada and Nagamine, to the N.N.E. of Kashiwasaki, in 1898 and 1899 respectively, a great impetus was given to the industry, and these fields are still the most important in Japan. Shortly after the discovery of these oilfields, Japan attracted the attention of the Standard Oil Company, who formed the International Petroleum Company, with a capital of a million pounds, to carry on the industry in Japan. A refinery has been erected by them at Naoetsu, and they have several oilfields to the east of and in the district of Naoetsu.

All the other companies working petroleum in Japan are Japanese. There are a great number of these companies, but the largest and most important is the Japan Petroleum Company, whose refinery is situated at Kashiwasaki (Nippon Sekiya Kabuiska Kaisha). Many of the smaller companies only use dug wells.

The chief oilfields are the "Higashiyama" and the "Nishiyama." The former lies about six miles to the E.N.E. of Nagaoka, and includes the districts of Urase, Hire, and Katsubo, which are continuous, forming one field. The latter (Nishiyama) is situated about six miles N.N.E. of Kashiwasaki, and includes the districts of Nagamine and Kamada,

which, the former extending to the latter in a north-easterly direction, form one field, including also some borings on the coast, a short distance to the west of Nagamine, viz., at Miyagawa.

There are numerous other localities and small fields where borings have been made or wells dug, notably at Niitsu, near Niigata, but for the most part only in small groups of, or isolated, wells, and in many of these the production has been falling, the oil becoming exhausted, and many have been abandoned, especially after the successful openings of the Kamada and Nagamine fields.

Geological Association of the Petroleum.

The petroleum in Japan occurs almost exclusively in the tertiaries, which formation covers large areas in Japan, especially on the west of Japan proper, in the provinces of Echigo, Noto, and Ugo.

As might be expected from the great tectonical movements and volcanic activity which have taken place in Japan as late as the quarternary period, and which are even continued, on a smaller scale, in the present day, the tertiaries are greatly disturbed, having been sharply folded, faulted, and otherwise affected by intrusive and contemporaneous volcanic rocks. This accounts for the abundance of oil outcrops in the oleiferous strata and for the fields not being of long duration. The natural oil outcrops result from the petroleum rising through fissures, as well as from the exposure of an oleiferous stratum.

Partly owing to the disturbed nature of the strata, even the active geological survey of Japan has not yet completed much of the classification of the tertiaries of Japan, although with the examination of the various fossil horizons advances are being made in this respect. Only in the island of Sado has any attempt at a subdivision been feasible, where a well defined upper and lower series is present, which are probably equivalent to the Miocene and Pliocene of Europe.

The strata associated with the oilfields are very sparsely fossiliferous, although a bed containing fossil fish outcrops east of the Higashiyama oilfield, consequently the strata cannot easily be subdivided or classified. Owing to this difficulty in the classification of the Tertiaries and their frequently disturbed nature which render the geolgical structure very complicate, not much is done in geological work connected with the discovery of oilfields, the boring sites being generally selected from the occurrence of native petroleum. In most cases, however, the productive fields are situated in the axial region of anticlinal folds, but the borings do not follow the anticlinal axes as strictly as desirable, too much lateral extension being allowed, and, in some cases, the wells are situated at some distance from the anticlinal axis.

Higashiyama Oilfield.

This field lies along the axis of an anticline running in a north and south direction in the hilly country bordering on the mountains of the interior. It comprises the districts of Katsubo, Urase, Hire, Katsurazawa, and Tsubakizawa, which are continuous in the order named from north to south.

The strata of the Tertiary are very disturbed, sharply folded and frequently faulted, and consist of a series of sandstones and shales intercalated with tufaceous deposits, and also with some calcareous shales. In some places on the west sandstone dykes traversing some calcareous shale can be observed. Thick masses of volcanic agglomerate with andesitic boulders overlie, and to a great extent hide the strata of sandstones, shales, &c.; thus rendering the determination of the geological structure more difficult.

The strata probably belong to an older series of Tertiary than those of Nagamine and Kamada, but are difficult of placing. Oil outcrops occur in exposures on the side of the hills and valleys, probably at points where an oil bearing stratum is broken into, but they may also rise through fissures and faults.

Urase is the most important and productive district, and in it there are many borings of the Japan Oil Company. It occupies the summit of a high elevation among the hills. Oil strata are struck at various depths ranging between 400 and 600 feet from the surface. The crude oil is heavy, though somewhat lighter than that of the Nishiyama district; that obtained in the vicinity of Urase and Hire is the best, the oil varying slightly in the different localities.

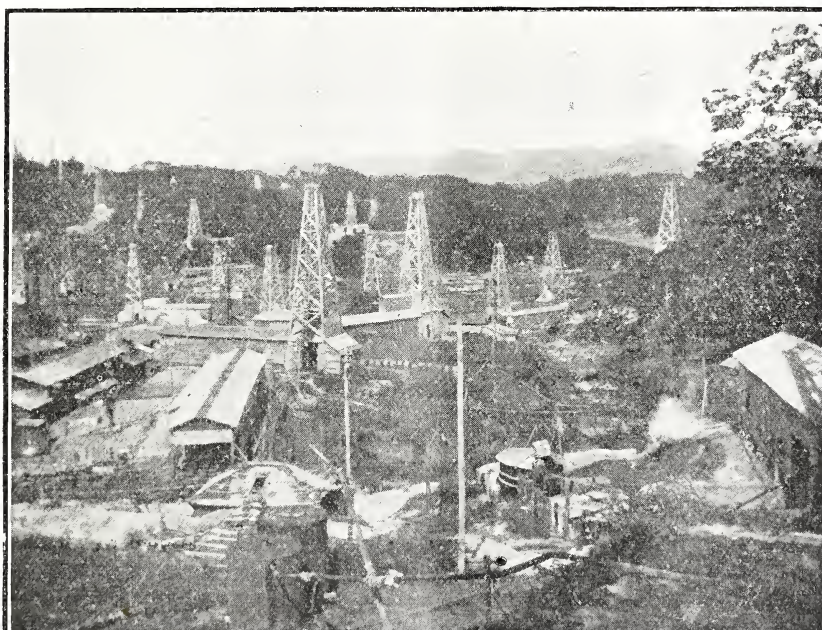
The immediately adjoining district of Hire also contains wells of the Japan Oil Company, while the adjacent field of Katsubo to the north and lower down, has one deep boring of the Japan Oil Company, but consists chiefly of dug wells belonging to various small companies. In the deep wells, the oil is raised by means of the cylinder or an unperforated sand pump, the others, at Urase, being pumped from a centre in which the ropes are pulled

from a horizontal wheel worked in a reciprocating motion by a powerful gasoline engine. In the Katsubo region of the field, which lies lower, on the north side of the hill on which Urase is situated, there are numerous hand dug wells, ranging to about 400 feet in depth, and ventilated by a form of bellows, which six or eight coolies work by foot.

Though the Japanese have adopted the American system of boring and methods, many of their appliances are somewhat rudimentary, but the originality of the Japanese does not find exception in connection with boring, and some of their devices, though rude and simple, are distinctly ingenious and also very serviceable.

a system of eccentrics, which is rotated by an electrically discharged gas engine. In other parts the engine working one pumping well is connected with several others. The petroleum obtained here is of a peculiar green colour and contains kerosene and benzine, also some sulphur as an impurity. The density is generally higher than that of the Higashiyama oils.

Exposures of the strata, which consists here of tertiary shales, clays, &c., are not very numerous, but an anticline can be detected on the axis of which the productive portions of the field are situated. The strata are practically unfossiliferous, and considerably disturbed, though not to such a great extent as in the Higashiyama district.



Nagamine Oilfield (Nishiyama).

The Nishiyama Field.

The position of this field, which includes the two districts of Nagamine and Kamada, has been mentioned above. The wells in these two districts are very much crowded together, especially in Kamada, where the production consequently decreases more rapidly. Drilling is being carried on at some distance to the north-east of Nagamine, where a well 2,030 feet in depth has recently been completed.

As in the Higashiyama field, the oil is brought to the surface in the deep wells by the cylinder. An extensive group of pumping wells is worked from a central engine-house at Nagamine, but here the ropes are attached to

The borings at Miyagawa, on the coast, which are included in the Nishiyama field, are not so favourably situated, and the production is small.

Productive oil sands have been reached at depths of 1,200 to 1,380 feet. A well has been bored here which is 1,440 feet in depth, being one of the deepest in Japan. The crude oil obtained here is very light.

Explanation of the Positions of the Oilfields.

The province of Echigo, in which the oilfields referred to are situated, lies on the west coast of the northern portion of the mainland

of Japan, between the 37th and 38th parallels of North latitude.

The positions of the chief towns referred to are as follows :—Naoetsu is situated on the west coast at about 10 minutes north of the 37th parallel of latitude. Kashiwasaki (in connection with which the position of the Nishiyama oilfield is given) is situated at about 45 miles miles along the coast (in a north-easterly direction) from Naoetsu. Nagaoka (referred to in connection with the Higashiyama oilfield) is situated further inland, to the north-east of Kashiwasaki, and about 13½ miles from the coast.

Niigata is situated on the coast, opposite the island of Sado, and close to the 38th parallel of latitude—(about 4 minutes south of it).

Other Localities.

In the vicinity of Niitsu, which is about 22 miles south of Niigata, upwards of sixty wells have been drilled, and the production is not inconsiderable. The oil has been obtained in this district from early times by means of dug wells. The Japanese method of hand-boring, known as the "Kayusa-bori," introduced in 1896, has been employed with success here.

The "Kubiki field" includes the oil fields situated to the east of Naoetsu. The Amaze field is situated to the north of the Nishiyama field, on the coast of the Sea of Japan. Borings have been made along the coast, and derricks have been erected in the sea for drilling. The deepest well in Japan (unless a deeper has since been drilled) is at Amaze, and is 3,074 feet in depth. The production has been gradually declining, the most prosperous time of this field being in 1894, and since the discovery of the Kamada Nagamine field it has been almost neglected. The latter may be said of most of the other smaller fields in the country.

It is very probable that there are numerous territories not yet touched from which petroleum may be obtained, and that there is scope for further developments.

It is possible that much may be done by geological investigation in finding suitable sites for boring amongst the tertiary formations in the east of Central and Northern Japan and in directing extensions of the existing oilfields.

There are numerous other localities in which native petroleum is known to exist (notably in the north-east of the Province of Ugo) and which have not yet been examined and exploited with a view to working for petroleum.

TEA TRADE IN PERSIA.*

The tea trade with Persia, which was checked for a time by the combined influence of the new customs tariff and of years of scarcity in the South, continues to grow in a manner that is quite satisfactory to India. Though the incidence of taxation on high grade Lamsars, and white teas, is, according to value, something less than the tax on black teas, it is heavy enough to drive, by increasing their cost, all but the very wealthy to abandon them in favour of cheap and medium priced pekoes and pekoe souchongs. From this change India benefits directly.

The total imports of all teas at all Persian ports are given by the Customs statistics for the following years ending March 20th :—

Year.	Weight.	Value.	Sterling.
	Yearly average. lbs.	krs.	£
1901 }		12,300,000	205,000
1902 }	5,734,400	13,000,000	216,667
1903 }		14,300,000	238,333
1904	6,921,429	16,873,220	281,220

These figures are not conclusive, for the increase shown by them in value is not in proportion to that in quantity, owing to shrinkage in the imports of the more expensive Java and China teas, which have been replaced by Indian teas of medium price and grade, and by lower quality China tea.

The increase would have been very much greater had it not been that, since the introduction of the new Customs tariff, large quantities of tea which used to be landed in Bandar Abbas, in transit for Trans-Caspian, Trans-Caucasian and Khorasan markets, whither the tea used to go *viâ* Yezd, are now sent round by sea. The new tariff, and the increased watchfulness of the Russian Customs officials, make tea-running across the border unprofitable, whilst at the same time Russia has attracted tea in transit for North Persia to Batoum by the opening of the Batoum-Julfa, and the Batoum-Ashkabad routes by lessening the cost of carriage.

The Banque d'Escompte de Perse has also been offering to purchase tea in Bombay, Java, or Batoum, on advantageous terms, *i.e.*, at a commission of one per cent. for clients in north Persian provinces, and its offers seem to have been well responded to.

The illicit trade in tea with Asiatic Russia through Persia has died a natural death to the disadvantage of Yezd, but a not inconsiderable smuggling trade in high grade Lamsars and white China tea has sprung up. These highly priced and heavily taxed teas, which are so much to the taste of Persians, are still sold and consumed in the south-eastern and central regions of Persia in quantities far greater than can be accounted for by the Customs figures, or warranted by the wealth of the community.

* Extract from the Report on the British Indian Commercial Mission to South-Eastern Persia, during 1904-5, by A. H. Gleadowe-Newcomen, F.R.G.S., President, Indian Tea Cess Committee.

The Arabs are not drinkers of tea, but within the last two years there has been a great increase in the shipments of tea into Koweit, and other Arabian and Turkish-Arabian ports. This tea is practically all re-exported, and is run in native craft across the Gulf to little known and unfrequented Banders on the inhospitable Persian coasts whence it is distributed up country. It may therefore be reasonably argued, that the falling off in the import of Appar and of high-grade Lamsars is not quite so great as the official figures seem to indicate.

What this apparent falling off amounted to may be gathered from the following figures, showing values of imports at the two great Gulf Ports of Bushire and Bander Abbas:—

	Country.	Value.		Increase.	Decrease.
		1903.	1904.		
		£	£	£	£
Bushire.	India	27,601	33,282	5,681	—
	China	11,526	16,585	5,059	—
	Ceylon	3,234	1,808	—	1,426
	Dutch E. Ind.	19,759	7,497	—	12,262

	Country.	Value.		Increase.	Decrease.
		1903.	1904.		
		Rs.	Rs.	Rs.	Rs.
Bander Abbas.	India	8,27,684	3,18,063	—	509,621
	China	2,43,562	47,916	—	195,646
	Ceylon	—	1,504	1,504	—
	Dutch E. Ind.	1,49,790	57,953	—	91,837
	Russia	—	75	75	—

The figures above quoted represent the movement of the tea trade till the end of December, 1904. With the coming of 1905, however, imports of tea at both ports (specially Indian tea), and at Bandar Abbas in particular, increased rapidly, and the figures for 1905, when published, will in all likelihood show a substantial increase.

The prices and demands have by now adjusted themselves fairly well to the new tariff duties, and there appears to be a considerable opening for Anglo-Persian firms which, by eliminating the many middlemen and their commissions, would deal directly with the Indian grower on the one hand and the Persian merchant on the other. There is not the slightest reason why tea could not be indented for on sample; indenting on, and supplying to sample would pay. The trouble found by one firm of merchants in Bushire who had entered into correspondence with a Ceylon tea firm was that the Ceylon dealers would take no notice of the samples and prices of teas in request sent them, but wanted to force what they had for sale on to the markets.

The Statistique Commercial for the year ending March 20, 1904, gives the following figures of tea imports in batmans (Man Tabrizi, 6·5 lbs.) and krans:—

Country.	Batman.	Krans.
	White tea.	(Sterling).
China	25,975 (= 1,518 cwt.)	623,878 (= £10,398)
British Empire	10,179 (= 595 ,,)	333,716 (= £ 5,562)
Dutch E. Indies	14,308 (= 836 ,,)	417,482 (= £ 6,958)
Russia	61 (= 3 ,,)	768 (= £ 13)

Country.	Batman.	Sterling.
	Other Teas.	
China	58,653 = 3,428 cwt.	640,714=£ 10,678
British Empire	834,685 = 48,793 ,,	12,509,748=£208,496
Dutch Indies	50,456 = 2,949 ,,	804,641=£ 13,411
Russia	62,548 = 3,656 ,,	1,536,094=£ 25,601
Turkey	326 = 19 ,,	6,172=£ 103

Note:—For Indian-Persian-English currency, Rs. 15 = Krs. 60 = £1.

The following c.i.f. quotations may be taken as representative:—

White Teas.—Silver-tipped leaves comprising both China and Java tea, the former known as "Appar," the latter as No. 1 "Lamsar," average price per 56 lbs., which is the weight of the China white chests, is, according to quality, from Krs. 350 to Krs. 450. White tea is in demand among the wealthy classes in the larger towns only. It is seldom or never used alone, but is blended with varying quantities of Indian, Java, or China black teas.

China Tea.—China tea, where it is white tea, has already been spoken of; there is, however, a substantial import of green and black teas from China. The Bushire quotation, per chest of 56 lbs., varies according to quality from Krs. 205 to 350. Little is imported *viâ* Bander Abbas.

Batavian Tea.—Some Batavian or "Lamsar" tea, as that of China, is white tea. In the southern markets, China and Batavian teas have been in close competition, with varying fortune. At one time it seemed as if Batavian tea was becoming prime favourite amongst the wealthy, who were discarding China teas for it. The bazaars of Kerman and Yezd, and, though in a somewhat less degree, Shiraz, were full of the green boxes of "Lamsar" tea, which found a ready sale everywhere. Recently, however, imports from Java have fallen off very considerably. In Bander Abbas imports of China tea fell off even more heavily than the former, but in Bushire, while Java fell off to the value of £12,262, China made an advance of £5,059, chiefly in green tea and medium Pekoe.

Bushire quotations in May, 1905, for "Lamsars," other than No. 1 white, were Krs. 280 to 380 per 80 lbs. according to quality.

Indian Tea.—Indian tea forms about 83 per cent. of all the tea consumed in Persia, and has benefited from the heavy taxation imposed on high-grade "Lamsars," despite the fact that these are, value for value, less heavily burdened by the Customs tariff than Indian teas. China and Java teas together used to form about 15 per cent. or 16 per cent. of the tea

consumed by Persians. They have now so appreciated in value that the very strong demand, which always existed for Indian teas (possessing fair flavour and aroma with a fair proportion of orange tips, and costing, landed in the Gulf ports, from $3\frac{1}{2}$ annas to $6\frac{1}{2}$ annas a pound), has increased. Those who before consumed "Lamsars" and China teas are now forced to turn to Indian tea in increasing numbers.

Indian growers and dealers ought, however, to remember that there is no market in Southern Persia for very highly priced teas ($7\frac{1}{2}$ annas per pound c.i.f., Bushire or Bander Abbas, is the outside limit) and no demand for broken teas and dust.

It is very evident that a tea answering the description of Lamsar, a blend of pekoe and of orange pekoe with a good percentage of tips, yielding a pale, straw-coloured liquor, and possessing a delicate flavour, a tea which will bear "stewing" on the samovar, is the tea that is preferred by Persians in every part of the country. They delight almost as much in the look of the leaf as in the flavour of the liquor. It ought, however, to be possible to get a flowery orange pekoe in India, if not from Assam or the Dooars, then from Kangra, Kumaon, Darjeeling or the Dun, that will yield a liquor such as the Persians like, and that will yet be able to pass the customs as black tea. The Persian wants, above all, an "economical" tea, that will stand a lot of drawing.

It is important for Indian producers to bear in mind the fact that the taste of consumers varies in Persia, and that what pleases tea drinkers in the north will not of necessity suit the people of the south, and *vice versa*. They must, therefore, study the country, paying great attention to the requests of agents and buyers from the different regions, and ask to be furnished frequently with ranges of samples and prices by which they are to work. I have already said how neglectful, at the very least, some sellers and growers of tea are of samples and prices submitted for their information and guidance by agents and merchants in Persia, and the tendency is, I fear, a common one.

Two cases have come to my notice which give some more or less solid reason for the mistrust with which Indian teas are viewed by the Persians, and I do not think that it will be out of place to mention them for the benefit of "the Trade" here :—1. At the beginning, traders in Indian teas saw their way to big profits and quick returns. Taking advantage of the increasing favour with which Indian teas were being received, owing to their good quality, certain traders imported the cheapest and lowest grade tea they could find in Bombay and Calcutta, dirt and sweepings most of it, stuff that cost them, landed in Kerman, 4 or 5 annas a pound ; this they palmed off on the Persians as Indian tea at Re. 1 to 1-4 per pound. It is small wonder that our tea fell into disrepute and that the Persians showed a preference for clean "Lamsar" in sealed boxes.—I heard this at Bam, and it not only explains in some measure the failure of Indian tea in those parts of Persia, but also emphasizes the necessity that exists for all merchants, interested in any particular trade, having trustworthy agents — or at least supervising agents of their own in Persia. 2. While at Shiraz, I found that there was one Indian tea that had entirely disappeared from the market and had not been seen for fifteen or twenty years. It was called "chahai siah" by the Persians, and as I could get no sample, though it was described as being a black tea, of large leaf and ugly appearance, poor in fragrance and yielding a very strong dark liquor, I conclude that it was "Souchong." It seems that a fairly large quantity of this tea used to be consumed, despite its strength and other poor qualities. People might have continued drinking it had not, as report goes, a certain Shazada Kamara Mirza, Niamat-u-Sultaneh Vazir-i-Jang, declared that on burning the leaf in a pan he had found traces of zanik, *i.e.*, orpiment or yellow arsenic. This frightened people and ultimately made the tea unsaleable throughout the whole country. I do not know what truth there is in this story, but it is certain that this black tea is no longer used, better grades of Indian teas and "Lamsars" having replaced it, as they are doing the "Appar" and green teas of China.

In the south the demand is for a tea, low priced, flowery, of even leaf, yielding a pale liquor, and possessing a delicate flavour, whilst broken teas and dust are disliked ; absolutely black teas are not cared for much, and the demand for green teas is small. In the north, a black tea, having a pekoe leaf, wiry and even, with few tips, is prime favourite, and leafy kinds are not much in demand.

It would be worth the while of Indian tea traders to have leaflets printed in colloquial Persian, describing the best method of brewing Indian tea, and the advantage of decanting the liquor from off the leaves when the tea was drawn, before putting it to stand over the coals in the samovar. The leaflets could be sent for distribution to agents and Consulates all over Persia. The consumption of tea in Persia is not going to decrease, but will increase. Nomads, Jews and Parsees, who used no tea formerly, are all becoming inveterate tea-drinkers now. The increase in the consumption of opium means an increase also in the consumption of tea, for every person addicted to the opium habit drinks an abnormal quantity of tea.

With the prospect of further development in the Indo-Persian tea trade, comes the necessity for fostering that trade in every way. Facilities must be placed in the hands of buyers, and sellers, in their own interest, must see to it that markets do not become overstocked, as was the case lately in Yezd and Tehran. The necessity for bonded warehouses increases daily. Bonded warehouses will enable importers and shippers to keep stocks at the ports, thus avoiding overstocking the up-country markets, providing against depletions, and saving an enormous percentage in money, as the duty, amounting in some cases to 100 per cent., need not be paid until stocks

are drawn upon, instead of, as at present, immediately on arrival of consignments at ports.

Russian Tea.—Russian tea, which is put up in packets, and in neat ornamental boxes, of 1 gervanker (= 88 miscals, or 14 oz.), and of $\frac{1}{2}$ funt and $\frac{1}{4}$ funt (18 lbs. and 9 lbs. respectively) has met with some success in the northern towns, where it has become fashionable. Small consignments have been tried in Ispahan, Shiraz and the southern markets, but these have not realised the hopes of the consignees, though the tea is sold in Shiraz at 7 Krs. per paper and foil packets of 1 gervanker. Of the Russian tea that I have seen, about 60 per cent. has been Ceylon and Indian, and about 40 per cent. China.

Persian Tea.—His Highness Prince Kashif-es-Sultaneh, formerly Persian Consul-General in Bombay, holds a concession for the growing of tea in the Persian Caspian Province, at Lahijan near Resht, where some 300,000 bushes now about five years old have been planted out. The climate of the place resembles somewhat that of the Dooars, and is well suited to the growth of tea; but though Mr. MacLean, in his report, states that the plants there, three years' old, were doing well, no Persian grown tea is on the market. His Highness is now making enquiries regarding the possibility of securing the assistance of British capital and skill in his enterprise.

PRODUCTION OF INDIA-RUBBER.*

I need hardly remind chemists that some of the most important discoveries in our science, and many of those which have had the most profound influence on the development of chemical theory, have arisen from the examination of the constituents of raw materials. The discovery of morphia in opium led to the recognition of the new class of alkaloids; the discovery of amygdalin in the bitter almond of the new group of glucosides; the investigation by Liebig and Wöhler of the chemical properties and composition of the essential oil of the bitter almond was largely instrumental in laying the foundations of modern organic chemistry; whilst it was during the examination of the constituents of bran that Fownes was led to the discovery of furfurol and the subsequent recognition of a new type of organic compound. In more recent times the examination of the constituents of oil of turpentine and various essential oils yielded by different plants has been the means of elucidating the chemical theory of the great group of terpenes, and latterly Harries' investigation of caoutchouc has led to the discovery of the ozonides which seem likely to be of much importance as a new means of determining the constitution of certain classes of organic compounds. Lastly, I may remind you that the discovery of helium might have been long delayed had not Professor Miers drawn Sir William Ramsay's attention to the so-called nitrogen furnished by the mineral cleveite.

I have thought that it would be of interest on the present occasion if some account were given in the Section of the chemistry of certain of the raw materials employed in the principal manufacturing industries of the city of York. These industries are vitally concerned with an adequate supply of certain raw products of tropical origin, especially cocoa and gums. In connection with the first of these, which has hitherto been obtained chiefly from the West Indies, a new industry of cocoa production has sprung up in West Africa, notably in the Gold Coast and in Lagos. This West African cocoa presents some peculiarities which have rendered it desirable to examine the nature of its constituents. Gums of the nature of gum arabic are at present chiefly derived from the French colony of Senegal. It is, however, clear from the examination of gum collected in West Africa that that country, and especially Northern Nigeria, will be able in the future to contribute to the needs of the British manufacturer, in addition to the Sudan, India, and Australia, which will also be able to make important contributions. In connection with the investigation of these gums derived from new sources, at the Imperial Institute, the very remarkable observation has been made that certain gums from India and the Colonies possess the property of evolving acetic acid when exposed to the air. The chemical constitution of one of these gums has been fully investigated at the Imperial Institute by Mr. H. H. Robinson, who will contribute a paper on the subject to the Section, in which he will show that the production of acetic acid is due to the elimination of an acetyl group by hydrolysis through the moisture of the air. He also succeeded in elucidating to a large extent the chemical nature of the gum. Mr. Robinson will also make a report on the present position of the chemistry of gums, a class of substances whose constitution is exceptionally difficult to unravel. Little, if any, advance has been made in recent years on the well-known researches of O'Sullivan.

There is no more important group of questions demanding attention from the chemist at the present time than those connected with the production of indiarubber or caoutchouc. An enormous increase in the demand for indiarubber has taken place in the last few years, and last year the production was not less than 60,000 tons. Until recently the supply of rubber came chiefly from two sources—the forests of Brazil, which contain the tree known as *Hevea brasiliensis*, furnishing the Para rubber of commerce, which commands the highest price, and the forests of Africa, where climbing plants, generally of the Landolphia class, also furnish rubber. The increased demand for caoutchouc has led to the extensive planting of the Para rubber tree, especially in Ceylon and in the Federated Malay States. Systematic cultivation and improved methods of preparation are responsible for

* Extract from the address of Professor Wyndham Dunstan. LL.D., F.R.S., President of the Chemical Section of the British Association at York.

the fact that the product of the cultivated tree, which begins to furnish satisfactory rubber when six or seven years old, is now commanding a higher price than the product of the wild tree in Brazil. It is estimated that within the next seven years the exports of cultivated indiarubber from Ceylon and the Federated Malay States will reach between ten and fifteen million pounds annually, and that after fifteen years they may exceed the exports of the so-called wild rubber from Brazil.

The services which chemistry can render to the elucidation of the problems of rubber production and utilisation are very numerous. Methods of treatment depending on a knowledge of the other constituents of the latex have led to the production of rubber in a purer condition. Much still remains to be elucidated by chemical means as to the nature of the remarkable coagulation of the latex. As is well known, the latex is a watery fluid resembling milk in appearance which contains the rubber, or as I think more probable, the immediate precursor of rubber, together with proteids and other minor constituents. The constituent furnishing rubber is in suspension, and rises like cream when the latex is at rest. On the addition of an acid, or sometimes of alkali, or even on mere exposure, coagulation takes place and the rubber separates as a solid, the other constituents for the most part remaining dissolved in the aqueous liquid or "serum." The first view taken of the nature of the coagulation process was that, like the coagulation of milk by acids, it is dependent upon a process of proteid coagulation, the separated proteids carrying down the rubber during precipitation.

This explanation cannot, however, be considered complete by the chemist, and there are peculiarities connected with the coagulation of the latex which are opposed to the view that it is wholly explained by the coagulation of the associated proteids. The experimental investigation of the question on the chemical side is beset with many difficulties which are increased if access cannot be had to fresh latex. A number of experiments were made at the Imperial Institute with latex forwarded from India. The difficulties contended with in preventing coagulation during transit were great, but in the case of the latex derived from certain plants these were to some extent surmounted and the results obtained, especially with reference to the behaviour of certain solvents towards the latex, led to the conclusion that "coagulation" can take place after removal of the proteids, and that in all probability it is the result of polymerisation of a liquid which is held in suspension in the latex and on polymerisation changes into the solid colloid which we know as caoutchouc. Weber by experiments conducted in South America with fresh latex, arrived at a similar conclusion, which later workers have confirmed. Although the nature of the process is not yet completely elucidated, there is little room for doubt that the coagulation is due to the polymerisation of a liquid and possibly of a liquid hydrocarbon contained in the latex. For the chemist, the important question remains as to the nature of this liquid from which caoutchouc is formed.

The chemical nature of caoutchouc is a subject which has attracted the attention of distinguished chemists from the middle of the eighteenth century, among them being Faraday, Liebig, and Dalton. Faraday was the first to examine the constituents of the latex of *Hevea brasiliensis*. It is only in recent years that our knowledge of the constitution of organic compounds, and especially of the terpene group, has rendered it possible to make any great advance. It is interesting to record that Greville Williams, in 1860, made most important contributions to this subject. He identified a new hydrocarbon, isoprene, as a decomposition product of caoutchouc, and recognised its polymeric relation to caoutchouc.

The results obtained from the analytical side, and especially the formation of dipentene and isoprene by pyrogenic decomposition of caoutchouc, had pointed to the fact that caoutchouc was essentially a terpenoid polymer of the formula $C_{10}H_{16}$. Harris finds however, that the ozonide of caoutchouc, when distilled with steam, breaks up into lævulinic aldehyde, lævulinic acid, and hydrogen peroxide, and he concludes from this that caoutchouc is a polymer of an 1·5 dimethyl cyclo octadien. Whilst Harries' work has brought us much nearer the goal, and has led to the discovery of a new method of investigation through the ozonides, which is obviously of wide application, it cannot yet be said that the constitution of caoutchouc has been settled or its relation to the parent substance of the latex definitely established. It has still to be shown how a closed-chain hydrocarbon such as Harries' octadien can undergo polymerisation forming the colloid caoutchouc.

There are strong arguments for the view that the constitution of the parent substance present in the latex is nearly related to that of isoprene. This remarkable hydrocarbon of the formula C_5H_8, first obtained by Greville Williams from the dry distillation of rubber, is an unsaturated olefenic hydrocarbon which is found among the products, resulting from heating caoutchouc. It readily polymerises, forming di-pentene. Bouchardat noticed that this hydrocarbon obtained from the pyrogenic decomposition of caoutchouc furnished a substance identical with rubber when acted on by hydrochloric acid and under other conditions. To Wallach and also to Tilden is due the further important observation that when isoprene prepared from oil of turpentine is kept for some time, it gradually passes into a substance having all the characteristic properties of caoutchouc.

I have very briefly drawn attention to the present position of our knowledge of the chemistry of caoutchouc in illustration of the interest which attaches to the examination of vegetable products, and also because of the immense importance of the problem from the practical and commercial standpoint. Chemistry in this case holds the premier position in reference to this subject, and to a large extent may be said to hold

the key to the future of the rubber industry in all its phases. The discovery of better methods of coagulation, preparation, and purification will be effected through chemical investigation, as will also the determination of the manner of utilising the various other plants which furnish rubber-like latices. That the physical properties of raw rubber, on which its technical value depends, are to be correlated with the chemical composition of the material there can be no doubt. The chemical analysis of raw rubber, as at present conducted is, however, not always to be taken by itself as a trustworthy criterion of quality, and more refined processes of analysis are now needed. Although the finest caoutchouc for technical purposes is only yielded by some half-dozen plants, under whose names these varieties of caoutchouc pass, there can scarcely be a doubt that the elastic substance in each case possesses a very similar, if not identical, chemical structure. Nearly all the latices and similar fluids furnished by plants contains more or less caoutchouc. Even opium, which is the dried juice of the capsule of the poppy, contains caoutchouc, whilst the opium yielded by certain Indian species contains a notable proportion. Chemistry must determine the means by which caoutchouc can best be separated from these relatively poor latices. In view of the increasing production of the nearly pure caoutchouc which is furnished by *Hevea brasiliensis*, *Funtumia elastica*, *Castilloa elastica*, *Ficus elastica*, and a few other plants which occur, or can be cultivated in several of our tropical possessions, the question is not a pressing one at the moment.

Moreover, it cannot be doubted that chemical science will sooner or later be able to take a definite step towards the production of rubber by artificial means. The production of caoutchouc by chemical means has, indeed, virtually been accomplished in its formation from isoprene. The exact nature of this change has still to be determined. When this has been done, it will only remain to cheapen the cost of production to make the manufacture of synthetic rubber a purely practical problem. I should be the last to discourage the great extension of rubber planting which is now taking place. It is warranted by the present demand for the material. It has also to be remembered that the actual cost of producing raw rubber, which is at present about one shilling per pound, will probably be reduced, and the market price of rubber may eventually be so considerably lowered that, as with quinine, the synthetic production could not be profitably carried on. That is a question which involves many factors at present unknown, and only time can decide. Chemists may, however, confidently predict that before the British Association again meets at York the synthetic production of rubber will be a fully accomplished fact.

As I have said, our science is concerned with nearly every problem connected with the great rubber industry, and in concluding these few remarks I may allude to the production of vulcanised rubber depending on the formation of additive compounds of the hydrocarbon with sulphur. In this connection I should mention the recent experiments of Mr. Bamber in Ceylon, which appear to show that vulcanisation may be accomplished by acting on the uncoagulated latex with chloride of sulphur. If this proves to be practicable, it may mean the transference to the tropics of the subsidiary industry of vulcanisation, which is at present carried on in Europe.

Owing to the importance and interest which attach to the chemistry of rubber, it is to form an important feature in the work of this Section at the York meeting. Papers will be contributed by some of the best known workers in this field, by Professor Tilden, and by Professor Harries, of Kiel, who will give an account of his recent work; whilst Mr. Pickles, of the Imperial Institute, will present a report summarising the whole of our chemical knowledge of the subject.

The chemical investigation of raw materials often raises, unexpectedly, problems of great scientific interest. The examination at the Imperial Institute of the seeds of the Para rubber tree (*Hevea brasiliensis*) has shown that they contain what proves to be a valuable drying oil, and in the course of the investigation it was ascertained that there is also present in the seeds an enzyme closely allied to, if not identical with, lipase, which is capable of splitting the oil by hydrolysis into glycerin and the free fatty acid. Subsequently, during the examination of other oil seeds similar enzymes have been detected, and it would appear probable that most oil seeds may prove to contain an enzyme capable of decomposing the fatty constituent.

THE COCHINEAL INDUSTRY.

The city of Cuzco, high up in the mountains of Peru, has always been the world's leading mart in the sale of cochineal, and although the business has declined to a mere fraction of its former proportions, Cuzco still exports to the United States and Europe more than £625,000 worth of the little insect every year. The cochineal insect was unknown to Europeans until the discovery of the New World, being a native of America only, but it is stated in a recent report of the International Bureau of American Republics, that it was soon cultivated, outside of Mexico and Peru, mainly in Algiers, Southern Spain, and the Canary Islands. The insect is very plentiful on the wild cactus plants of the desert regions of Southern California, New Mexico, and Texas, but it is of no commercial value, for the reason that the dyes produced by its use are pale, insipid pink in colour. That this is due entirely to the influence of the climate is proved by the fact that when Mexican

insects are taken to California, they lose their valuable characteristics, while California insects, moved to the southern republic are indistinguishable from those native to Mexico. Of late years, the cochineal industry has greatly declined. Probably there is not one-tenth as many nopalries (cochineal plantations) in existence to-day as there were twenty or twenty-five years ago, and it seems not unlikely that before many years have passed the business will be abandoned entirely. This is mainly due to the competition of cheaper, and in most cases inferior dyes, compounded in the laboratories of the chemist. The most important of these are products of coal-tar, which have been put to a multitude of uses by modern scientific methods. Besides many different dyes, printer's ink, black varnish, flavouring extracts, and a large number of drugs and medicines are extracted from coal-tar. For the finest class of goods, however, where great permanence and unfailing brilliancy are desired, no satisfactory substitute for the little tropical American insect has yet been discovered. How long this peculiar industry has been carried on in America no one knows. When Cortes conquered Mexico, he found many great nopalries in operation, and there is no doubt that this form of agriculture was then many hundreds of years old. Some of the districts of Mexico paid their tribute to the king, Montezuma, in cochineal, which was the only dye used in colouring garments of royalty and the nobility. Specimens were sent to Spain in the year 1518, and so greatly was King Ferdinand pleased with the brilliant colours produced by its use, that he instructed his viceroys in America to obtain the finest dyes they could. Ever since that time cochineal has been considered one of the finest dyes, and its production has been an important industry. There is no more curious and interesting industry than cochineal farming. The cochineal thrives in Mexico, Peru, and some other countries of tropical America, on the nopal plant, sometimes called the cochineal fig, which closely resembles the common prickly pear. These plants are grown on large farms or plantations called nopalries, which form the basis of very valuable scarlet, carmine, and orange dyes. The nopal plant is a kind of cactus. It thrives only on the elevated plateaus of the interior, where for seven months of the year rain is never known, and where almost all forms of vegetation but cactus plants and mesquite bushes wither and die. Often it grows to a height of ten or fifteen feet, but generally when it grows so tall it becomes top-heavy and falls on the ground, taking root anew wherever it touches. A nopalry is started by simply placing cuttings in the ground, fifteen or twenty feet apart, at any time during the rainy season. The only cultivation necessary is to keep down the growth of mesquite plants and to cut out all surplus nopal plants in order that they may not grow too close together. If this is neglected the plants will soon become crowded and lose their vigour, and the insects found on them will become few in number and produce only dim and sickly colours. Where the cochineal insect comes from is something of a mystery. Wherever a nopal plant comes up, the little creature is almost certain to be found on it. For this reason it was supposed to be a seed or bloom of the plant, and it was not until the year 1703 that the great Leeuwenhoeck discovered that it was an insect. Had he not been aided in his investigations by the newly-discovered microscope he would hardly have solved the mystery even then, as the living female insect, which is twice as large as the male, weighs only one-tenth of a grain. Much of this weight is lost when dried; about 70,000 being required to weigh a pound. During the rainy season, many millions of the little creatures are drowned or washed off the plant, so that when the long dry summer arrives, there are but few survivors on each plant. They multiply, however, very rapidly, and before long every plant is nearly covered. How long the cochineal insect lives has not yet been ascertained. Some say its period of existence is measured by hours, while others claim that it lives for several days, but all agree that its life is short. The females outnumber the males by at least 200 to 1, which is very fortunate from the point of view of the planter, as the males are entirely valueless. The last act in the life of the female, is to lay a large number of eggs, upon which her dead body rests, protecting them from the burning rays of the sun until the little ones emerge. In about six weeks after the beginning of the dry season, the insects are sufficiently numerous to justify the first harvest of the season. The plantation labourers make the round of the nopalry, armed with a brush and a wide-mouthed bag, held open by a loop. With the brush they go over every part of each plant, sweeping the tiny creatures into the bag by thousands. They are then killed by immersion in hot water, by exposure to steam, or being placed in hot ovens. Those killed by hot water or steam turn a very dark reddish brown, and are marketed under the name, "black cochineal." Those killed in hot ovens are of a greyish-red colour, and are known as "silver cochineal." Another variety, called "granilla," is composed of insects gathered from wild plants, and is, therefore, very inferior to those secured from nopalries. The dead insects are next placed in the sun on sheet iron plates and allowed to remain there until perfectly dried, when they are ready to be packed in ounce, quarter pound, and half pound packages. They are then ready for market. Enough of the little animals escape the brush and bag of the gatherers to begin to repopulate the plants. In about two months they are again as numerous as at the time of the first gathering and then harvest is gathered. During the seven months of rainless weather three gatherings take place, the last about a month before the beginning of the rainy season, in order that there may be time for the insects to increase in numbers sufficiently to ensure that enough will survive the constant rains to stock the plantations for the next year.

BORDEAUX INTERNATIONAL MARITIME EXHIBITION, 1907.

An International Maritime Exhibition in celebration of a century of steam navigation, will be opened in Bordeaux on May 1st, 1907, under the auspices of the League Maritime Française, recognised as an establishment of public utility by decree of December 17th, 1905. It will remain open until November. The exhibition will be held under the official patronage and aid of the French Government, and the Department of the Gironde, the Municipality, the Chamber of Commerce, and the Philomathic Society of Bordeaux.

The exhibition is international, and all industrial, agricultural, or artistic products pertaining to maritime affairs will be received. A Colonial section will be devoted to Colonial products which are intimately related to the commerce of Bordeaux. Pavilions will be devoted to ocean geography, nautical automobilism, and aërial navigation.

During the exhibition the Commissioner-General will organise congresses, competitions, and lectures on maritime affairs, science, art, industry, commerce, and social economy.

The exhibition will be constituted into a bonded warehouse, consequently the products exhibited will be exempt from verification, custom house and octroi taxes. Exhibitors shall pay rent for the space they occupy.

The following is the general classification:—Group I.—Marine History and Fine Arts. Group II.—Instruction. Group III.—Charts and Instruments. Group IV.—Navigation and Commerce. Group V.—Navy. Group VI.—Materials for Construction. Group VII.—Motor Machines and Propellers. Group VIII.—Fittings and Apparatus. Group IX.—Automobile Navigation and Boats of all types. Group X.—Aeronautics. Group XI.—Port and Harbour Works. Group XII.—Sea and River Fishing. Group XIII.—Hygiene, Salvage and Sports. Group XIV.—Ship's Provisions, Food. Group XV.—Various Industries: Interior decoration of passenger steamers and yachts. Mariners' and passengers' clothing, sporting attire. Special furniture for passengers' steamers and yachts, &c. Travelling articles, &c. Group XVI.—Commercial Relations of Bordeaux with the Colonies. Group XVII.—Social Economy. Works of Mutuality and Charity.

Further information can be obtained from the Commissioner General, Monsieur E. Bertin, Member of the Institute; or from Mons. V. Morlot, Deputy Commissioner-General, Bordeaux.

AUSTRALIAN MARBLE.

According to the American Consul at Sydney, the marble deposits in New South Wales are the finest in the world. Some of the quarries are easily worked, without the use of any mechanical appliances, and yielding large-sized blocks of a good quality. The Consul says that not only are the deposits of variegated marble in New South Wales among the finest in the world, but if properly worked and developed they should give the means of livelihood to thousands of workers in quarrying, carting, working the material, &c., not only for local consumption, but for exportation. Unfortunately for the industry, the quarries are being worked by bodies of men who have not the funds available for opening up these quarries, and for keeping on hand a sufficient number of blocks of marble to meet a sudden demand, or the properties belong to persons who are too extensively occupied in other directions to admit of their devoting the necessary time to the development of this industry, which, if properly worked, would, it is said, give a better return than many a gold mine. The men, it is added, are working without the necessary appliances, and they have too much unsuitable machinery, without the expert knowledge of the needs and requirements of the market, and have not sufficiently studied the purposes to which marble can be applied.

ITALIAN CHERRIES.

Although the cherry crop of Italy is a heavy one, and the packing industry is extensively carried on, the larger part of the output for export goes to Central and South America, which market takes the entire product of Lombardy, and very little appears to be shipped to European countres. By the Italian processes, cherries to be packed in spirits are brought to the factories to be cleaned by women. They are then subjected to the sulphur bath to preserve their colour, and are afterwards passed through three alcohol baths in which the strength of the fluid is increased from the thirty to the sixty grade. The entire processes of preparation occupy nearly forty days. Male labour is employed throughout after the cleaning process, at wages approximately one shilling and eightpence per day. When bottled for shipment the cherries sell at about one shilling and twopence per pound. Preserved or candied cherries take the sulphur bath, are then stoned, cooked in sugared water, to which sweetening is gradually added, and are then left for two or three days in the basins until the sugar slightly ferments. They are then boiled again in water, in which the proportion of sugar is increased, and on finishing are either sold for candied cherries or are bottled in a heavy syrup. Women do the cleaning, and pick the cherries, men do the rest. These cherries sell at about one shilling and sixpence per pound. The best cherries are produced in Salerno, the second quality are produced in great numbers in the provinces of Brescia and Bergamo.

HOME INDUSTRIES.

Iron and Steel Trades.—Reference was recently made in these notes to the extraordinary expansion in the production of the pig iron of the world, and the export trade of this country shows no signs of decrease. Germany continues to take the largest quantities, but France and Belgium have also taken large amounts, shipments to France establishing a new record. It is in the export trade that British activity is shown, as the figures below (which give the shipments of pig iron from Middlesboro', for July, and for the seven months ended July 31) indicates. These figures are those of Messrs. William Jacks and Company, of Middlesboro' :—

Destination.	July. 1905.	July. 1906.	Seven months ended July 31st. 1905.	Seven months ended July 31st. 1906.
Scotland	23,368	35,942	173,673	224,393
England and Wales	10,316	10,510	67,012	74,834
Foreign	51,574	86,426	304,540	509,936

It will be seen that the increase, so far as England and Wales are concerned, has been comparatively small; the increase in the demand for Scotland has been very considerable, but it is in the requirements of the foreign market that the extraordinary expansion is visible. Here the demand was never greater, and there is every indication of continuance. From Germany, Belgium, France, orders may be expected that will keep up the shipments. And it is only in England that there is any considerable reserve. America and Germany are straining every effort to turn out pig-iron, but consumption grows the faster, for the building of new furnaces and the laying down of plant is a work of time. The difference between America and Germany, and England, is that in the two former countries home consumption is growing by leaps and bounds, whereas the English home trade is much less active. In his annual report, Mr. Swank, the general manager of the American Iron and Steel Association, writes :—" The production of iron and steel in 1905, as compared with 1904, was simply marvellous. Our production of pig iron in 1905 exceeded the whole world's production in 1887.'' In 1905 it was 22,992,380, and the prediction is that this immense output will be exceeded in 1906. Most of it is for home consumption, only 953,858 tons being exported in 1905. With us the orders booked for forward delivery have been on a very large scale, and shipments are at least not likely to show any decrease until the end of the year, the probability being the other way. The stocks of Cleveland No. 3 still amount to about 600,000 tons, but large as is this reserve it is not out of proportion to the probable requirements of the trade, for neither Germany nor America has been able to build up a reserve. The outlook for home consumption too is better, a lot of work being booked which will necessitate large purchases of raw material not later than the autumn.

Hematite Iron Ore Supplies.—Recent inspections in the Furness district have led to the conclusion that there are entirely new and important hematite iron ore fields in Mid-Cumberland awaiting opening up, and that the fields are so situated as to be available to the county's smelters, and also to others outside, by shipment at Silloth. Should further investigation and workings confirm this opinion, the importance of the discovery could hardly be over-rated. The output of the North Lancashire and Furness hematite iron ore mines may be expected soon to show contraction, and unless new iron ore fields can be opened up, England must become more and more dependent upon imported ores, a prospect not to be regarded without misgiving.

Merchant Shipping. — The Merchant Shipping Acts Amendment Bill is one of the several important measures which will come up for final consideration in the autumn session. It left the Standing Committee on Trade considerably altered, and it is likely to provoke sharp discussion when Parliament considers it in the autumn. It is a far-reaching measure, dealing with many complex subjects, intended to give effect to the reports of three committees, and touching highly contentious matters. It deals with the law as to passenger and emigrant ships, to registration, the method of measurement in ascertaining tonnage, the treatment of seamen, the application of British regulations to foreign ships while they are within any part of the United Kingdom, the engagement of foreign seamen who cannot understand the English language, and much else. One of the objects of the Bill is to lessen the number of foreign seamen in the British mercantile marine, but should the Bill became law it may well have the contrary effect. Probably the language difficulty has been exaggerated. A foreign seaman may be unable to speak English and yet understand the few words of command given by the skipper. Nor is it easy to understand why, if the language difficulty is the real danger it is assumed to be by some people, the language clause of the Bill does not apply to any British subject or inhabitant of a British Protectorate. Is it less dangerous for a British subject to do the wrong thing through not understanding orders than a non-English speaking alien? And whilst the language test is not to apply to the British subject, the Workman's Compensation Bill makes the shipowner liable to compensate not only every foreign seaman injured in his employment, but also, in case of death from injury, to compensate the family, or dependents, of the foreigner. It was suggested that the foreigner should be excluded from the benefits of this clause, but it was objected that this would be to offer a premium to British shipowners to employ as many foreigners as possible in preference to British seamen, and it may be taken that Parliament will not sanction this exclusion. But what with these liberal provisions in case of accident or death, the better food and living-space to be provided on ships, and other benefits accruing to the seaman, should the Bill become law, foreign seamen will be more than ever anxious to serve in British ships, and the English-speaking condition will probably not counter-

balance the increase. Other provisions of the Bill, such as the application of British regulations to foreign ships whilst they are within ports of the United Kingdom, the application of British law as to load line to all foreign ships while they are within British ports; and the detention of foreign ships when they are unsafe owing to defective equipment whether such foreign ships take in cargo at our ports or not; whilst on their face desirable changes in the existing law, and required by equity, need, as no doubt they will receive, very careful consideration by Parliament. It is a delicate matter to interfere, however indirectly, with foreign ships, and such interference might well lead to reprisals not to be lightly invited.

The Motor Car Industry.—In the six months ended June 30 there was an importation of foreign motor cars of the value of £1,299,262, representing 3,217 cars, and the value of parts during the same six months was £1,010,819. These figures, however, include the number and value of cars sent to the Continent for touring purposes which are included on their return as imports. The bulk of the imports come, of course, from France. Going back a little the value of the exports to the United Kingdom from the three chief exporting countries of motor cars, motor cycles, and parts thereof was as below in 1903-5:—

	Germany.	Belgium.	France.
	£	£	£
1903....	33,651	68,180	1,636,574
1905....	231,051	414,909	2,580,517

It will be seen that whilst France remained a long way ahead of other foreign countries, sending us last year cars, &c., of more than six times the value of the imports from Belgium, and eleven times the value of the imports from Germany, the growth of the imports, from both Germany and Belgium during the two years to the end of 1905 was very rapid, as was to be expected having regard to the immense increase in the demand for motor cars, and the comparative backwardness of the home industry. There are many signs, however, that British manufacturers are making strenuous endeavours to take the place that rightly belongs to them in this great industry. New works, and extensions of old works, are to be seen in various directions. The Argyll works have been greatly enlarged; the Humber Company has just bought a large piece of land in Coventry for a new factory, in which to concentrate their motor car department; the Daimler Company has made a similar purchase with the same object; the Wolseley Company are making important additions to their factory; the Birmingham Small Arms Company propose to devote the factory recently acquired from the Government to the manufacture of motor car components; the Brotherhood-Crocker Company will soon be in occupation of their new works in Sheffield, and the demand for Rolls-Ryce cars necessitates further extension of the facilities for production; in Coventry various new features and extensions to existing works are being planned, and many engineering firms are seriously considering the question of manufacturing motor cars. For some time to come the imports of motor cars, &c., from abroad must continue large, for the British works cannot, as yet, cope with, nor for some time to come be able to cope with, the immense and still-growing demand for motor cars. It is impossible to measure the potentialities of this young industry, but it ought before very long to be as rare a thing for a motor-car order to go abroad as it now is to go there for locomotives.

English and Foreign Locomotives.—Speaking of locomotives, in his recent report on the finances and condition of Egypt and the Soudan Lord Cromer includes a memorandum from Mr. F. Trevithick, which gives some instructive particulars of tests made with 35 engines, built by firms of different nationalities to the same designs, and having generally identical working conditions. In 1901 Neilson supplied 10 engines, and these were followed in the first half of 1902 by 15 engines from Hentschel and Son, of Cassel, and 10 from the Staatseisenbahn, Vienna. These 35 engines, constructed to the same design, and identical, so far as the eye could judge, were stabled at the same depot, engaged on similar work, and attended to under similar conditions. Up to the end of 1905 they had run an average exceeding 120,000 miles, and they had all passed through the shops for their first general repairs. Taking the average mileage of each engine as 120,000, the results of the comparison of the three makers with regard to the cost of coal, oil, and repairs, worked out as follows:—

	Coal.	Oil.	Repairs.	Total.
	£	£	£	£
British	2,271	117	660	3,048
German	2,290	108	685	3,083
Austrian......	2,362	105	708	3,175

The average number of miles run by the British engines before entering the shops for their first general repairs, and their average coal consumption in pounds per mile, was 59,684 and 37·02 respectively; the German figures were 59,804 and 37·12; and the Austrian 52,519 and 38·66. The initial cost of each engine was, British £3,245; German, £2,917; Austrian £2,935. Mr. Trevithick's conclusion is that "as regards their working and cost of maintenance the three makes of engine are practically the same, the slight difference in favour of the British being equalised by the extra initial cost. The finish, however, of the British-made engine is more carefully studied than that of either of the others and is well worth paying for."

The Electrification of Railways.—The Midland Railway Company have decided to electrify their Lancaster, Morecambe and Heysham lines, and the Brighton Company will begin the constructional work of electrifying the South London line between Victoria and London-bridge next month. It may

be assumed that before long the question of main line electrification will reach the practical stage. This conversion is only a question of time and probably of no long time. Naturally Railway Boards shrink from very large additions to capital already large until they have strong grounds for the belief that it will pay. The main factor is the freight traffic. If this service can be done at higher speed and lower cost main line conversion must come, and it is believed that these advantages can be safely counted upon. Mr. D. N. Dunlop deals with the question in the *Times*, and he is clearly of opinion that the electrification of trunk lines cannot be long delayed. It is already admitted that suburban passenger traffic can be better handled by electric than by steam power, but it is not the passenger traffic that will settle the matter. The real question at issue involves the economic operation of the heavy goods traffic on which the chief trunk lines depend for their main revenue. The passenger traffic is becoming less and less profitable. The Board of Trade returns show that during 1904, as compared with 1903, the increase in the number of passengers conveyed by all railways was 0·3 per cent.; the increase in passenger train mileage was 3·3 per cent., and the increase in receipts from the same source was 0·9 per cent. The increase in expenditure was greater than the increase in receipts, and the extra traffic was carried at a loss. The reverse is the case with freight traffic. Taking the same period the increase in tonnage of goods was 1·40 per cent., nearly all due to mineral traffic; the decrease in train mileage was 2·8 per cent.; but the direct increase in receipts from goods traffic was only 0·5 per cent. Year by year the goods traffic becomes more remunerative, the passenger traffic less so. Passengers want more accommodation for less money, larger train units, and more powerful locomotives, reduce the cost of carrying freight per mile. But with the steam locomotive the practical limit of power has been reached by the best grade of modern engines consistent with the configuration and construction of the permanent way. With electricity, says Mr. Dunlop, it is possible to haul a longer train and a heavier load than with the highest grade steam locomotive. As to the cost of electrification, it varies greatly, but Mr. Ward Leonard, who has given this subject close attention, is of the opinion that with the best system the electrification of existing railways would mean an increase of total capital of about 10 per cent. if the same total horse-power were provided, which means that the electrification of the trunk lines would involve an increased capital of about 125 millions. That, of course, is a very heavy burden to add to the existing weight of capital, but if, as seems probable, the consequent increase in earning capacity would more than compensate for the outlay, it is not likely to be very long before one of the great railway companies gives the start destined to make electricity the motive power upon trunk lines.

GENERAL NOTES.

VENEZUELAN TRADE.—Reporting on the trade of Caracas (No. 3675, Annual Series), Mr. Vice-Consul Haggard refers to a peculiar characteristic of the market. It seems that cloth and dry goods in general are only saleable at certain fixed prices to the Venezuelan population, prices which have existed from time immemorial, and which have survived half-a-century of effort on the part of European manufacturers and of the Venezuelan dealers. The Venezuelan bolivar or franc is divided into two reals, and four medios, the latter about 2½d., and these coins supply the only prices at which the goods are bought. The "medio print," the "real" (5d.) or "real y medio drill," and so on at regular intervals, are the only kind sold, and the circumstance naturally leads to a somewhat unusual state of affairs. The well-tried allurements of 11¾d. or 4s. 11½d.—so familiar to the British shopkeeper—are impossible to his Venezuelan counterpart. In consequence, the work of the wholesale merchant, when buying abroad, and when fixing his price to the local retailer, becomes a matter of some nicety and adjustment. Material might be bought in the United Kingdom, for instance, at 15/16d. a yard, a price which would probably allow of its sale to the public by a retailer at the medio stipulated for. Mr. Haggard explains these peculiar conditions of trade by saying that in former times, especially when the railways were building and gold was being brought into the country in large quantities by the foreign companies engaged in their construction, small coins were scarce, and in the interior at least there was an absence of small change with which to carry on trade.

CLOVES.—Zanzibar and the neighbouring island of Pamba are great exporters of cloves. In 1905 they exported them to the value of £287,073, the United Kingdom taking cloves to the value of £54,709, and India to no less than £132,236. Mr. Vice-Consul Sinclair (3677, Annual Series) quotes the Director of Agriculture as of opinion that at least four or five times the present crop might be raised locally, and attributes the falling off, which first became evident in 1899, partly to the cost of picking, and partly to the prohibition by the Government of the laying of arsenic, by which means the natives were, up till then, in the habit of destroying the wild pigs, which play great havoc with native crops, especially in those parts of the islands where chillies are grown. The price, which at the beginning of 1905 was, for Zanzibar cloves 11s. 4d. per frasila, rose to 18s. 8d. in August, the average for the year for Zanzibar cloves being 14s. 5½d., and for Pemba cloves 13s. 5½d. per frasila. The fluctuations were principally caused by the operations of speculative syndicates in the United Kingdom and in India. The clove crop of Zanzibar last year was the largest of which any official record exists, amounting to 227,178 cwts. (755,543 frasilas).

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FIRE, FIRE RISKS AND FIRE PREVENTION.

By Professor Vivian B. Lewes,
Royal Naval College, Greenwich.

Lecture I.—Delivered March 12th, 1906.

Science has taught us that matter is indestructible, and that although our candle may disappear as a candle in performing its useful function of supplying us with a somewhat fitful light, the constituents of which it is composed are not lost, but have merely assumed new and gaseous forms. Comforting as is this knowledge of the indestructibility of matter in the abstract, it affords but poor solace to the unfortunate householder whose worldly belongings have been destroyed by fire, and who sees the collected household treasures of a lifetime being wafted heavenward in a cloud of smoke, steam and carbon dioxide.

Fire losses are, as far as we are concerned, absolute losses, as the products of combustion are of use only to Nature, and although the owner of the consumed property may be fully insured, the loss is merely distributed amongst the community. As the annual monetary loss in the British Isles alone has been placed at £70,000,000 per annum, it is clear that the subject of fire, fire risks, and fire prevention deserves all the attention that can be given to it.

A glance at the existing English literature on this subject soon convinces the reader that, although much attention has been given to the methods by which fire may be fought, and the methods of building most likely to check its ravages, yet there is plenty of room for a treatment of the subject from a scientific standpoint, which after all affords the only sound foundation for our efforts to lessen the risk of fire, and when unfortunately started to render it as little dangerous and destructive to life and property as possible, and it is from this point of view that I desire to treat the subject in these lectures.

Few periods in the world's history have made so indelible a mark on the tablets of time as the latter half of the eighteenth century, and much of the lustre with which that period was endowed was due to the beautiful scientific researches of the "Prince of Philosophers," Antoine Laurent Lavoisier, who, born in 1743 when chemical science could hardly be said to exist, devoted his life to researches on the subject of combustion, and gave us the first true explanation of the cause and nature of fire.

Starting with the discovery that a substance burnt in air gave products of combustion heavier than the original body, he gradually arrived at the fact that air is necessary for combustion, and was able with these weapons to attack and overthrow the phlogistic theory of Stahl, which had ruled supreme during the earlier years of the century, and which attributed combustion to the escape of something pre-existing in the combustible material. Then came the discovery by that triumvirate of genius, Priestley, Lavoisier, and Cavendish, of the composition of air, and that, instead of being an element, as had always been supposed, it contained oxygen and nitrogen. It was the discovery of oxygen by Priestley in 1774 that in reality placed the means of completing his research on combustion in the hands of Lavoisier, and it was whilst studying the avidity with which the wonderful element urged on all the phenomena of combustion that he came to the conclusion that combustion was in truth the evolution of energy during the rapid rushing together into combination of the combustible body and the oxygen of the air. Then it was that Lavoisier earned for himself the gratitude of every lecturer on chemistry who has had to hide the baldness of his eloquence by the beauty of his

experiments, by first showing the wonderful combustions of phosphorus, sulphur, charcoal, and steel in oxygen.

In all these cases the phenomena observed are dependent upon the formation of combinations of oxygen with the bodies burnt, the phosphorus yielding us phosphorus pentoxide, the charcoal carbon dioxide, the sulphur the gas we know as sulphur dioxide, whilst the steel, the only one of these substances be it noted which burns absolutely without flame, yields the solid oxide of iron as the result of the combination. During these conditions energy is developed, and owing to its intensity by concentration into a short space of time this energy manifests itself as heat and light.

Here then is to be found the key to all the actions which we speak of under the general term of "fire," and further experiment soon shows us that in order to start this rapid combination between the substances oxidised and the oxygen of the air, it is only necessary to heat the combining bodies to a temperature known as the "ignition point," a temperature which varies very widely with different substances, but which is a constant factor in all bodies of the same composition. Some substances, such as certain organic compounds with zinc, ignite below the ordinary air temperature, and such bodies are called "spontaneously inflammable," whilst others, like phosphorus, have only to be slightly warmed in order to produce the rapid combination known as combustion. Others, again, like coal, have to be heated to a temperature of a little over 500° C. before their ignition point is reached, whilst bodies like steel, having their ignition point above the temperature reached in ordinary combustion, are looked upon, as a rule, as non-combustible.

The spread of ordinary fire and flame is due to the fact that when combustion is started by the ignition point being reached, the combustion raises the temperature generally well above the ignition point of the burning body, so that as one particle burns it ignites the next, and this action continues until the burning body has entirely combined with oxygen, but if the heat generated be insufficient to raise the body to the ignition point, combustion ceases as soon as the external heat is withdrawn. In the case of a watch-spring burning in oxygen gas, the combustion of a piece of german tinder attached to the end of it is sufficient under the exciting influence of the pure oxygen to raise the spring to the point of ignition, and then the temperature developed by the oxidation of the metal in the oxygen is sufficient to continue the combustion until the whole spring is burnt away. But if instead of allowing the action to go on in the pure oxygen the spring, whilst still vividly burning, is withdrawn from the jar of oxygen into the air, combustion ceases, after a few moments, owing to the dilution of oxygen in the atmosphere by nitrogen lowering the intensity of the combustion, so that the ignition point of the metal is no longer reached.

It is an action of this character that safeguards our atmosphere, the main constituents of which consist of 20·9 per cent. of oxygen diluted with 79·1 per cent. of nitrogen. If an electric discharge be passed through the atmosphere a flame is seen to burn above the spark, and oxides of nitrogen are produced in abundance, showing that at the temperature of the electric discharge the nitrogen and oxygen are undergoing combustion. The moment, however, that the discharge is stopped the action ceases, as the temperature produced by the combustion itself is so low that it is unable to induce the continuance of the action. Were it not for this the first flash of lightning, by starting combination between the constituents of the atmosphere, might denude the globe of its aerial envelope.

Although the igniting point of any substance is a fixed and unalterable temperature, the size of the mass to be ignited plays a very important part, as the smaller the mass the more easy is it to raise it to the ignition point.

For instance, iron ignites at about 1,500° C., and gunpowder at a little over 250° C., yet if some alcohol in a dish be ignited and finely divided iron dust be thrown into it, the iron burns brilliantly in the flame, whilst grains of gunpowder may be thrown through the flame without ignition, and will remain unacted upon in the alcohol until it is nearly all burnt away, when the flame, burning down to them and being in contact with them for some time, heats them to the necessary temperature and so ignites them. In the same way a very small flame held in contact with a block of wood fails to ignite it, whilst a splint or shaving cut from the block is easily lighted by the same flame.

So far we may summarise the facts with regard to combustion by saying that combustion is the generation of energy as heat by extremely rapid chemical combination, which is brought about by the ignition point of the

substances entering into combination being attained.

Although the ignition point marks the temperature at which ordinary combustion gives rise to the phenomena of light and heat, the same chemical action may be proceeding at temperatures short of the ignition point, but at so slow a rate that the energy developed is able to spread itself to the surrounding objects and so escape our notice. All those processes utilised by Nature for the cleansing of the surface of the earth and the conversion of waste matter back into carbon dioxide and water vapour, which are the food of Nature and from which she can reconstruct everything anew (processes which are generally spoken of as decay), are actions of this character. It must, however, be remembered that for a given weight of material converted by chemical combination into the same compounds, whether the reaction be slow, as in decay, or rapid, as in ordinary combustion, the total amount of heat generated is the same, the only factor in the action which varies being the length of time over which the development of energy is spread.

A tree left to rot upon the ground gradually disappears in the course of years, being mainly oxidised into gaseous products such as carbon dioxide and water vapour, and yet scarcely any evolution of heat is observed, although the same amount of heat is generated as if the tree had been cut into logs and burnt.

We have seen that if a steel watch-spring is taken, and a small piece of german tinder attached to the end of it is ignited and plunged into a vessel of oxygen gas, the combustion of the tinder ignites the watch-spring, which burns away in the gas with the greatest brilliancy, and the evolution of heat is sufficient to fuse the metal, the final result being that the watch-spring is converted into a chemical compound of iron and oxygen.

We can approximately judge the amount of heat developed in this experiment by the fact that the steel watch-spring is fused as it burns, which we know requires a temperature of 1,500° C. If, however, we took a second watch-spring of the same weight as the first and exposed it to moist air for two or three months, it would also be converted into oxide, but in the slow rusting away of the metal no appreciable heat could be distinguished, it having been dissipated to the earth, the air, and the surrounding objects as rapidly as it was generated. If, however, we could construct a calorimeter sufficiently delicate to measure all the heat evolved during the slow rusting away of the metal, we should find that exactly as much heat had been developed as would have been the case had it been burnt away in pure oxygen. Indeed, the atmospheric rusting of iron may become so rapid as to create a temperature sufficiently high to attract our attention: as for instance, when a mixture of sawdust and iron filings is swept up from a workshop floor and the heap moistened with water. After a few hours it is found that steam is being evolved, the heat of oxidation having been kept in by the non-conducting sawdust until the temperature had risen to the evaporation point of the water.

The more finely the iron is divided the larger will be the surface which it will present to the oxidising influence of the air, and if by chemical means we can prepare extremely finely-divided iron in an atmosphere devoid of oxygen, on throwing the powdered iron into the air it rusts so quickly as to become red hot. The action taking place below the ignition point is chemically identical with the action taking place during rapid combustion, and only differs from it by being spread through a longer space of time, and is, therefore, called "slow combustion."

Substances which are capable of entering into this condition of slow combustion constitute serious fire risks, as it is only necessary for them to be collected in sufficient quantity to enable the surrounding material to keep in the heat for the temperature in one part of the mass to rapidly increase. Inasmuch as the increase of temperature further hastens the chemical action, the heating becomes more and more rapid until the ignition point of the whole is reached, when the entire mass bursts into active combustion.

Cases of this kind, in which the temperature of ignition is reached by the heat of slow combustion being kept in by non-conducting material, are called "spontaneous combustion," or "spontaneous ignition," and will be fully considered under storage risks.

The ordinary phenomena of combustion, as we commonly know them, consist of incandescence, flame, and smoke, and as we have seen the prime cause of these three is the rapid evolution of energy developed during the combination of the combustible with the oxygen of the air. If a substance be a solid which is non-volatile at the temperature of combustion, or which is not decomposed by it into gaseous products before burning, incandescence alone is the result of the combustion, whilst all flame is caused by the combustion of gaseous matter.

We know that if bituminous coal or resinous wood be burnt flame is formed, whilst if coke or charcoal be used as the fuel no flame accompanies the primary combustion, this being due to the fact that in the former case hydrogen and carbon in various forms of combination are driven out from the coal or wood by the temperature generated in the combustion, and being in the form of gaseous or vapourous products burnt with flame. When these hydrocarbons, however, have been got rid of in the gas maker's retort or the charcoal burner's heap, it is the residual carbon alone that burns, and being non-volatile at the temperature employed no flame results, save under conditions which will be described later.

The smoke which accompanies most ordinary forms of combustion is a product of great complexity, and differs very widely with the nature of the substances being burnt. Practically all our forms of fuel, and by far the largest proportion of the substances consumed during a fire, contain carbon and hydrogen as their most important constituents, and with free access of air the products of combustion consist of water vapour and the two oxides of carbon, carbon dioxide and carbon monoxide. The proportion of these present depends upon the mass of incandescent carbon, the amount of air which can gain access to it, and the condition of the surface of the fire, so that with a brightly burning mass of timber urged on in its combustion by a brisk wind, and with the surface well alight, practically nothing but carbon dioxide escapes in company with water vapour, whilst if the interior of the mass be well alight, and air is only slowly passing through it, and the products escaping from the surface at a comparatively low temperature, then smoke containing a very high percentage of carbon monoxide will also be formed.

Of the three gaseous products of combustion steam alone plays an important part in the formation of smoke, whilst the other important constituents are tar vapour, minute particles of unburnt carbon, and ash, drawn upwards by the draught created by the fire.

The popular idea held by many is that smoke consists mainly if not entirely of particles of carbon rendered slightly adhesive by tarry matters, and that it is in fact like the soot we find deposited in our chimneys. But the microscopic examination of smoke reveals a far more interesting condition of things. A very beautiful experiment, first made I believe by Mr. Frederick Hovenden, is to show that if we take the smoke from a cigar or from a cigarette and blow it into a little glass chamber highly illuminated from below by focussing upon it the beams from an electric lantern or lime-light, and examine it under a microscope, it presents a most remarkable and wonderful appearance. Such smoke contains no particles of free carbon, but appears to consist of an immense number of little round particles in the wildest condition of commotion and movement, each particle rushing about and never coming into contact with its neighbour. Indeed, it presents as beautiful a picture as one could imagine of the molecular movement with which theorists have endowed matter. On still further examination these little particles prove to be tiny vesicles, the skins of which are formed of condensed vapour and liquids from the burning substances which give rise to them. These vesicles, being filled with gases, are excessively light, and float in the atmosphere until brought forcibly in contact with some surface, which causes them to burst and deposit the liquid film, so setting the contents free.

Whether this cloud of floating vesicles be derived from a cigarette, a coal fire, or the crude gas as it leaves the gasmaker's retort, or from one of those huge conflagrations with which our fire brigade has to deal, if we collect them in such a way as by friction to burst the tiny vessels, we obtain a liquid which comes under the generic heading of "tar," this tar being a highly complex mixture of many different organic liquids formed by the action of heat on the constituents of the burning matter, whilst the gases which escape from the interior of the vesicles on the rupture of the skin consist of nitrogen, carbon dioxide, carbon monoxide, hydrogen, traces of oxygen, and such hydrocarbons as methane.

In the smoke, however, from the combustion of a coal fire, or the conflagration of a store containing textile fabrics or much resinous wood, the smoke forms a heavy black cloud, the deepening of density and colour being due to the presence in it of minute particles of unconsumed carbon, which have been deposited during secondary chemical actions taking place in the flame of the burning material.

Take, for instance, the case of a building in which a fire is just commencing, the smouldering wood, carpets, &c., not yet in full blaze, give out a whitish smoke of no great density and very choking character, consisting almost entirely of these floating tar vesicles produced

by the distillation of compounds of carbon and hydrogen at temperatures of about 700 to 800° C. When, however, the premises are well ablaze, especially if it should happen to be an oil store, then besides the white smoke we get the dense black smoke, due to the presence of large quantities of carbon particles.

The heat of the combustion raises the air around to a very high temperature, and as all gases expand under the influence of heat and become lighter than the surrounding atmosphere, a strong up-current is at once formed, which sucks fresh air into the fire, so aiding its combustion, and at the same time draws up from the fire itself large quantities of particles of ash and still burning material, so that the smoke clouds which roll away from the fire consist of:—1. Water vapour. 2. Tar vapour. 3. Carbon particles. 4. Particles of ash. 5. The gaseous products of combustion. The variations in the smell and suffocating effect upon the men are due to the varying properties of the tar vapour distilled off from the substances undergoing combustion.

The amount of carbon in smoke is far smaller than is generally supposed, even when it is given off by bituminous coal under the imperfect conditions of combustion existing in an ordinary fireplace.

The subject of smoke from the point of view of danger to life during conflagrations deserves far more attention than it has ever received, as far more lives have been lost from suffocation than from actual burning.

We all know how different is the smell of smoke arising from different substances, and that when present in not too large quantities the nose can detect the nature of the smoke. For instance, tobacco smoke, the smoke from burning soot, from rags, from timber, or from animal matter all differ in smell so widely and are so distinctive that very little experience enables an observer to form a conclusion as to what form of material is burning. As the smoke grows denser the nose becomes less able to differentiate the smell. The irritating effect of the smoke on the eyes, nose, and respiratory organs increases, until a certain density is reached when the smoke-laden atmosphere becomes irrespirable and consciousness ceases.

This difference in smell is almost entirely due to the liquid envelopes of the tiny vesicles that constitute the principal portion of the smoke, the liquid being composed of the products of the action of the heat upon the burning substance, which are mostly of the same character as the products that would have been obtained if the substance had been subjected to destructive distillation in a retort. Coal-smoke has the mawkish gassy smell of the hydrocarbons developed in its distillation, tempered by the sulphur compounds emitted at the same time; burning wood, on the other hand, owing to the oxygen present in the cellulose that forms its main bulk, gives smoke acrid and pungent to the eyes and nose, owing to pyroligneous or acetic acid, the vapours of wood naphtha, acetone, and similar bodies.

Smoke is nearly always worst in the early stages of a fire, and although in the day time it is often the best fire alarm possible, at night it is a serious danger to the sleeping inmates, and hampers the rescue work of the firemen. Being formed during combustion the gases within the floating vesicles and the other products are expanded by the heat which formed them, and are lighter than the surrounding air and rise, so that even in a room full of dense smoke breathing is possible close to the floor, whilst anything which will filter off the tar vesicles and dust leaves the air in a condition fit to breathe for a certain time.

The construction of a satisfactory smoke and dust respirator for use by firemen under conditions where the smoke is so thick as to seriously impede their labours is by no means an easy problem, and of the hundreds of such appliances that have been suggested and made, very few even approach efficiency.

In making such an apparatus it must be remembered that simplicity, lightness and compactness are essential. At the same time the filtering material must be sufficient to arrest the tar vesicles and particles of dust and carbon without offering so much impediment to the passage of air as to render breathing difficult, because the need for the helmet will probably arise under conditions of considerable exertion.

During the early stages of a conflagration when there is more smoke than fire, a good smoke respirator or filter of simple construction would afford much help, as the poisonous products of incomplete combustion are absent, but when a fire has been in progress for some time and there is a considerable mass of incandescent carbonaceous matter at the seat of the mischief, a large proportion of the product of incomplete combustion, carbon monoxide, begins to make its appearance with the smoke, steam, and carbon dioxide. This introduces a new and serious source of danger to the

workers owing to the intensely poisonous nature of the gas.

The increase in quantity of this gas with increase in the mass of burning material is due to several factors :—

1. When the mass of incandescent matter is large the amount of air is rarely sufficient to complete the combustion, and carbon monoxide is produced.

2. With increase of temperature the proportion of monoxide to dioxide increases with great rapidity.

The playing of water on to the incandescent carbonaceous mass and the action of the steam generated on the glowing carbon yield carbon monoxide.

It might be imagined that as carbon monoxide ignites at about 700° C. and burns readily in air, forming the comparatively harmless carbon dioxide, there would be but little chance of any escaping unburnt with the products of combustion, but dilution plays an important part in preventing the combustion of such gases, and air may contain from 16 to 18 per cent. of oxygen still left in, and yet extinguish the flame of carbon monoxide if there be any considerable percentage of carbon dioxide present in it.

It is generally stated that air which extinguishes a flame is irrespirable and will not support life, but it has been shown clearly that if the oxygen in the air be reduced to about 17 per cent. and the carbon dioxide increased to between 3 and 4 per cent., either by respiration or by combustion, although a candle placed in this air will be at once extinguised, the mixture may be breathed by a healthy man for a very considerable period without any noticeable effect being produced.

Carbon dioxide is not a poison but acts by keeping the oxygen of the air away from the lungs, and in small quantities by interfering with the diffusion processes which, in the lungs, enable the blood to discharge the carbon dioxide formed in the body, and to re-oxygenate itself from the inhaled air. When 6 per cent. of carbon dioxide is present in the air, men inhaling it begin to pant and show signs of distress, which becomes severe with 10 per cent., whilst 15 per cent. soon leads to unconsciousness.

With carbon monoxide, however, a distinct toxic action is set up with the presence of even small traces in the air inhaled. The gas forms a definite compound with the hæmoglobin of the blood, and so prevents it from carrying out its normal functions; 0·1 per cent of carbon monoxide in the air will, after half an hour's breathing the atmosphere produce inablity to walk, whilst 1 per cent. will produce unconsciousness in a couple of minutes, followed by death if the man "gassed" is not quickly removed to an uncontaminated atmosphere. Should a man be overcome, artificial respiration and the inhalation of pure oxygen is the only treatment to employ.

The history of attempts to produce apparatus providing a means of breathing smoke-laden air for any length of time affords the best idea of the difficulties that have to be overcome. Amongst these attempts some of the earliest were breathing-tubes, consisting of a muzzle fitting to the mouth with valves connected to which were long tubes, which remained in the open air and down one of which the wearer breathed, whilst fresh air was sucked in through the other. These were exceedingly awkward to manage, especially when corners had to be turned, and the skin friction of the air passing through the tubes rendered respiration extremely hard.

An improvement of this idea was to have an air-bag with a short tube, which enabled a man to enter an atmosphere of smoke and remain in it for two or three minutes. A more complex apparatus was the smoke jacket, consisting of a blouse of cowhide fitted with a helmet over the head, the ordinary water hose being screwed in to an inlet in the blouse, into which air instead of water was pumped by the engine, whilst in the same clumsy class of apparatus Aldini's fire-protecting suit, consisting of asbestos covered by fine wire gauze and surmounted by a helmet, may be placed.

In 1875, Professor Tyndall, in conjunction with Captain Shaw, devised and introduced the smoke cap, which consisted of a hood of calf-skin, fitting practically air-tight over the head and shoulders, and which carried goggles for the eyes, and in front of the mouth a valve for expired air and a filter tube through which the air could be respired. The tube was closed with wire gauze at each end, and contained alternate layers of wool, wool moistened with glycerin, freshly burnt charcoal, and freshly burnt lime, the whole apparatus weighing about four pounds.

In such a smoke-filter the wool moistened with glycerin is especially active in retarding the passage of such particles of dust and vesicles of tar vapour as could pass the dry cotton-wool, whilst the charcoal exercised a certain amount of absorbtive effect on the

gaseous products of combustion, the lime taking up the carbon dioxide.

In the smoke-helmets used at the present time no attempt is made to rely on filtration of air to render it fit for breathing, as it is recognised that to be of real service a helmet of this kind must render it possible for a man to enter any atmosphere, poisonous or otherwise, and the only way to do this is to keep him supplied with fresh pure air.

Perhaps the apparatus most used for this purpose is a survival of the old air tubes known as König's patent respirator. It consists of a helmet, fitted with goggles, a valve for escaping air and inlet to which an air tube is attached; the neck of the helmet is made of soft leather which straps round the man's neck. The air tube, which may be of any length, is attached to the helmet, the other end being fixed to double-acting bellows worked by a man in the outer air, which drives fresh cool air round the face of the wearer, and the air being under slight pressure prevents the entrance of any gases or smoke to the helmet, the air finally escaping through a valve in the top of the helmet.

This form of smoke-helmet is popular with the men, as a small attachment near the bellows, allows the tube to be used as a speaking tube, so that the man wearing the helmet can keep in communication with the man outside, and direct operations. Thus the feeling of isolation is done away with.

In case of a great disaster, such as a theatre or hotel fire, where the rescue of a large number of people has to be conducted rapidly, more independence of action than would be given by the König apparatus is needed, and for this purpose the Vajin-Bader helmet is excellently adapted.

It consists of a fire and gas-proof helmet, fitting tightly on to the shoulders and carrying mica eyepieces with revolving cleaners; a metal cylinder, attached to the back flap of the helmet, is filled with air under pressure, and this is allowed to escape slowly into the body of the helmet, the foul air leaking out through the shoulder pieces.

Another excellent piece of apparatus of the same type is the Chapin-Sherman cap, which comes from San Francisco, and consists of a light oiled silk cap covered with fire-proof material and connected with air reservoirs strapped on the fireman's back.

The supply of air carried is larger than with the Vajin-Bader apparatus, and the air cylinders, being lower down the back, form a ledge that would help in the carriage of an unconscious person on the fireman's back.

As we have seen, rapid combustion or fire is induced when the ignition point of a substance is reached, but in studying the causes of fire one soon discovers that they are by no means limited to those cases in which the combustion is caused by the direct application of flame or other source of heat, many secondary actions tending to bring a mass of material accidentally to its ignition point.

On taking the causes of fire as revealed by the statistics of any large town, one generally finds that matches in one way or another are a most prolific cause, whilst defective vents and flues or fireplaces, owing to the overheating of beams and woodwork near them, also mount up to a very large total, the other cases being due to a number of causes, amongst which the spontaneous ignition of goods in bulk plays an important part.

Taking the fire returns for 1904 in London, Liverpool, Manchester, Glasgow, Leeds, and Sheffield, we find that the chief ascertained causes of fire were:—Matches, 1,695; overheating from defective flues and fireplaces, 853; gas, 464; oil, 408; candles, 327; whilst a myriad of other causes make up the remainder of the list.

EARLY HISTORY OF THE LONDON GUILDS.

Sir Owen Roberts in his address as Chairman of Council at the opening meeting of the Society on November 15th last showed how the old London Guilds and Livery Companies filled in the Middle Ages the position of fosterers of the arts, manufactures, and commerce of the country, which in the eighteenth century was assumed under changed conditions by the Society of Arts. A few notes on this interesting subject may be given here as further illustrating Sir Owen Roberts's thesis.

It was found quite early in the history of the country that arts, manufactures, and commerce required fostering, and that a special organisation was necessary for this purpose. When this fact was generally realised the idea of Guilds was evolved. The Saxons were hardworking but not adventurous, and although they appear to have favoured the idea of Guild co-operation largely for social purposes, it was not until after the Norman Conquest that fraternities of traders were formed. Various suggestions have been made

as to the origin of the Guilds. Some have traced them to the Roman Collegia, but this view is not now in favour. Others have considered them to be of native origin. Dr. Brentano, in his Essay on the History of Guilds, boldly affirms—"I write to declare most emphatically that I consider England the birthplace of Gilds." Dr. Cunningham, however, sides with those who believe in a foreign origin. He writes, "Some reason has been adduced for believing that craft Guilds (or *corps de métier*) existed in the Norman, Flemish, and German towns in the twelfth century, and were first introduced into this country as royally authorised organisations among alien artisans settled in English towns."*

The early history of the Guilds is still unwritten, and we require much more documentary information than at present is available before we can place the disconnected facts in their proper order. At all events, there are several points of importance which need careful consideration. We hear much of Guild merchants or Merchant Guilds, but we know very little of them in London, and we have therefore to deal chiefly with Trade Guilds.

The earliest reference to Trade Guilds is in 1180, when eighteen of these were amerced as "Adulterine" Guilds for not having paid their fines or licences. Rates of payment must therefore have been fixed before that date, and the Mercers claim to have been in existence in 1172. The Saddlers also, when mentioned immediately after the Conquest, are said to possess "ancient statutes."

In the next century there was a great division between the merchants and the craftsmen. Thomas Fitz-Thomas (Mayor 1261-1265) and Walter Hervi (Mayor 1272) strongly favoured the latter. After a severe struggle the merchants decided to join the craft Guilds, and gradually they obtained an ascendancy in them. In the year 1388-89 two writs of 12 Richard II. were issued to the Sheriffs of London (and of every shire in England). The first writ was addressed to the master and wardens of all social Guilds, and the second to the master and wardens of the Craft Guilds. By some fatality the returns from the Craft Guilds have been lost, but those from the Social Guilds were published by Mr. Toulmin Smith.†

Each trade, and, in some instances, divisions of a trade, had a separate Guild, so that the records of these Guilds ought to provide us with materials for a history of trade in the Middle Ages; but unfortunately most of the early documents have been lost, so that it is not always easy to prove by external evidence the manner in which the Guilds grew into Livery Companies. What we do know, however, is that this transformation was carried out during a considerable period of time.

On account of the difficulty alluded to, some writers have expressed doubts as to the intimate connection between the Guilds and the companies. This is, of course, a complete mistake, although in some instances we are unable to fix the exact date of the amalgamation. It was evidently found that to carry out the public work of the Guilds with complete success it was necessary to unite small Guilds of similar interests into one important Company, for judicious union has ever been found to lead to strength.

The latter half of the twelfth century was the great period of the formation of some of the chief Guilds. Many of these were formed into Livery Companies in the fourteenth century, although many Guilds (afterwards changed into companies) remained in the fifteenth and even the sixteenth centuries.

The importance of the woollen manufacture in the history of English industry was shown at an early period, and the formation of the Guilds connected with different branches of the industry present a good illustration of the manner in which the different Guilds were united into companies. The Fullers and the Weavers were the first craft Guilds to come into notice. The Guild of Weavers (the Cloth and Tapestry Weavers of London) long held a specially independent position. It was recognised by Henry I., and the first charter of incorporation was granted by Henry II. in 1184. The special privileges given to these craftsmen created a strong jealousy among the citizens, and King John was induced to suppress the Guild. The suppression did not however last for long, and we find in the reign of Henry III. the feud between the citizens and the Guild again in full force. When the authorities of the Guild feared that the citizens would overpower them, they delivered their charter into the Exchequer, to be kept in the treasury there, and to be delivered to them again when they should want it, and afterwards to be laid up in the treasury. In 1300 the Mayor had gained the right to preside in the Weavers' Court if he chose, and to nominate the wardens

* "The Growth of English Industry and Commerce during the Early or Middle Ages." Fourth edition (1905), p. 337.

† "English Gilds," edited by Toulmin Smith, 1870 (Early English Text Society).

of the Guild. Now the Company which represents this once powerful Guild has fallen to the position of one of the last on the roll of the Livery Companies.

The earliest official notice of the Shearmen who held an important position in the production of cloth is in 1456, when they came into possession of "a tenement and mansion-house," &c., in Minchin-lane, where now Clothworkers'-hall stands. Although the shearmen were not incorporated in a Guild until the year 1482, they must have been in existence long before this. The Clothworkers' Company was formed in 1528 by the union of the fullers with the shearmen. By this time, some of the Guilds connected with the woollen manufacture had been already incorporated with the Drapers, who dealt wholesale in cloth, and with the Merchant Taylors who made goods out of it.

How great an influence on the Government of the country was exerted by the leaders of the various Companies, is seen in the history of England, more especially in the reign of Richard II., when in the feuds between the Victualling and the Clothing Companies, the leaders were ranged on different sides at Court.

Among the Companies having special powers over the respective trades with which they are connected, may be mentioned Fishmongers, Founders, Goldsmiths, Gunmakers, Scriveners, Stationers, Brewers, and Vintners.

These powers were special, and imposed upon the several Companies, but all the Companies have duties to perform in respect to their various trades, and were unwearied in their efforts to keep up the credit of their trades by punishing those guilty of frauds. The influence of the Companies gradually decayed, owing to the new conditions of trade, and the relaxation of prohibitions which had become irksome and injurious to the growth of the business of the country. Some of the old Companies became extinct, and in certain cases, although the Companies continued to exist, the trades they represented were no longer active, such as Bowyers, Fletchers, Armourers, &c.

The influence of the Companies or Trade Guilds was gradually lessened partly by reason of the custom of "patrimony" which caused a large proportion of the members to be unconnected with the trade supposed to be represented by the Company.

The Companies continued to do their proper work, but they were not adventurous in search of new duties, and during the stirring times of the Civil Wars they suffered considerably as they also did in the reign of Charles II.

In the Report of the City of London Livery Companies Commission, 1880, the claim made for the companies as the fosterers of Trade and Commerce is strikingly acknowledged.

It is there said that the Companies became in effect a Municipal Committee of Trade and Manufactures.

Soon after they arrived at this position, on their incorporation in the fourteenth century, they became an institution in the nature of a State Department for the superintendence of the Trade and Manufactures of London.

It is worthy of notice in passing that although the Guild system was general all over the country, now scarcely any of the Guilds which once were so powerful in the old cities and towns remain, and London stands alone as retaining so many of these relics of a past phase of human society.

In the nineteenth century the renewed interest of the London Companies in the technical advancement of the trades they are interested in, worked not only for the benefit of London trade, but for that of the whole country.

THE CUSTOMS' REPORT.

The fiftieth Annual Report of the Commissioners of His Majesty's Customs shows that the net receipts from the duties on foreign spirits continued to decline, the decrease in 1905-6 being £97,839, or 2·56 per cent., as compared with the receipts for 1904-5, and this follows on a decrease of £635,936, or 14·3 per cent. in the preceding year. This is mainly due to a remarkable falling off in the importation of Germa plain spirit both for potable and industrial purposes. The proportions of the total foreign spirit revenue derived from each of the main classes of spirits in 1905-6 were, from rum, 57·68 per cent., from brandy 30·47 per cent., and from other spirits 11·85 per cent. The quantity of rum retained (including imitated rum) for home consumption shows little variation during the last five years, being 4,083,414 proof gallons in 1901-2, and 3,905,932 gallons in 1905-6, which, having regard to the increase in population, shows a slight decline in the consumption per head. The importation of imitation rum, which is the produce of countries in which the sugar cane is not grown, is inconsiderable. The quantity retained for consumption in 1901-2 was 26,164 proof gallons, and in 1905-6 only 10,943 gallons. In brandy the decrease in the quantities retained for consumption is more marked, being 2,310,665 proof gallons in 1901-2, as compared with 2,055,411 gallons only in 1905-6. Of these 2,055,411 gallons 429,439 were in bottles. The revenue from foreign spirits other than rum or brandy decreased from £477,524

in 1904-5 to £441,201 in 1905-6, which followed upon a decrease in 1904-5, as compared with 1903-4 of £526,933. If, however, spirits used for industrial purposes are excluded, the decrease is much more marked. In 1901-2 the quantities retained for home consumption amounted to 1,944,599 gallons, in 1905-6 they fell to 750,865 gallons. The variations in the quantities of foreign plain spirits are mainly governed by the quantities of potatoes available in Eastern Europe for conversion into spirits. Plentiful supplies produced low prices from 1901 to 1903, consequently spirits of this kind displaced home made spirits to a greater extent than in either 1904 or 1905, when supplies were shorter and prices considerably higher. The imports of foreign plain spirits amounted in 1901 to 1,741,406 proof gallons, and the average declared value was 9·30d.; in 1905 the import fell to 186,934 gallons, and the average declared value rose to 18·41d.

The quantity of tea retained for consumption continues to grow. In 1901-2, it was 232,115,384 lbs.; in 1905-6, 261,585,171 lbs. The consumption per head of population, which between 1900 and 1902 was 6·10 lbs., fell in the three succeeding years to 6·00, but it is noticeable that the increase in duty did not arrest the fall in the average value of imports, which has been continuous since 1891. The following figures illustrate this:—

Year.	Duty.	Average value of imports per lb.	Consumption per head. lbs.
1891	4d.	10·70d.	5·39
1901	6d.	7·67d.	6·10
1904	8d.	7·24d.	6·00

No doubt the higher duty affected prices, but it would seem that the public preferred a cheaper tea to paying the higher price. Of the total revenue obtained from the tea duty in 1905-6, 58·14 per cent. was contributed by India, 34·45 by Ceylon, and only 2·47 by China; all other countries contributing 4·94 per cent.

The tobacco revenue shows considerable changes. The quantities of foreign manufactured tobacco, and cavendish manufactured in bond, taken for consumption, fel from 2,666,685 lbs. in 1901-2, to 2,173,818 lbs. in 1905-6. But this decline has been considerably more than counterbalanced by the steady increase in the quantities of raw tobacco imported for home manufacture. The quantity of raw tobacco cleared for duty in 1905-6, as compared with 1904-5, shows an increase of 4,764,837 lbs., but against this must be set an increase of 2,476,926 lbs. in the quantity of tobacco presented for drawback. In the past year, the exports of British manufactured tobacco showed a considerable increase, and with the object of affording greater facilities for the development of the export trade in British manufactured tobacco, the minimum weight allowed to be exported as merchandise has been, in the case of cigars and cigarettes, reduced to 12 lbs. net. A more important concession has also been made by the issue of regulations authorising the exportation of British manufactured tobacco direct from the manufacturer's premises by the Foreign and Colonial Parcels Post, in quantities as small as 2 lbs. net, which may include any number of varieties. A considerable trade is in this way being developed in small parcels of British manufactured tobacco posted direct to the foreign or colonial consumer, and small packages of trade samples can also be sent without loss of the duty paid.

The statistics show that the consumption of wine continues to diminish, although the rate of decrease exhibited in 1904·5 has been checked. In 1904-5 the duties yielded £1,185,508, a fall of 11·3 per cent. as compared with the receipts of 1903-4. The receipts of 1905-6 show a fall of 0·82 per cent. only as compared with those of 1904-5. The fall in the quantity of wine retained for home consumption during the last five years is as from 14,865,330 gallons in 1901-2 to 11,784,193 gallons in 1905-6. Taken as a whole, the consumption of wines imported in cask was less by 189,885 gallons in 1905-6 than in 1904·5. The consumption of cask wine subject to the lower rate of duty was not sensibly diminished, but there was a falling off in the clearance of stronger wines to the extent of 5·68 per cent. As regards wines imported in bottle, there was a decrease of 0·51 per cent. in deliveries from bond of still wines, but an increase of 5·31 per cent. of sparkling wines, chiefly champagne.

The smuggling returns, apart from an important and exceptional seizure of the cargoes of two Dutch coopers captured by H.M.S. *Argus* inside the three-mile limit off the Humber, show little change. All told, the seizures for the year ended March 31 last numbered 3,797, of which 3,629 were seizures of tobacco, cigars, and foreign spirits, 12,372 lbs. of tobacco and 186 gallons of foreign spirits, having been seized. The whole of the sound tobacco seized is sent to the criminal lunatic asylums for consumption by the inmates, and the tobacco not fit for consumption in this way, but useful for fumigating purposes, is sent to the Botanical Gardens at Kew and Edinburgh.

Tea would seem to be a favourite article of adulteration. Of 2,906 samples submitted for analysis, only 2,391 passed the test. Of 737 samples of Dutch butter, 71 were reported to be adulterated, and of 92 samples of margarine analysed, 58 were found to be improperly marked and described. The Commissioners say "it is to be regretted that the penalties imposed in the prosecutions have on several occasions been insignificant in amount, even in cases in which the adulteration has extended to large consignments of considerable value."

A GENERAL SUPPLY OF GAS FOR LIGHT, HEAT, AND POWER PRODUCTION.*

The question of a cheap and abundant supply of energy is one of vital importance to this country.

* Paper read by A. J. Martin, M.Inst.C.E., before Section G of the Meeting of the British Association at York.

During the present Session a large number of Bills for the supply of electrical energy to London have been before Parliament, and a Select Committee of the House of Commons has recently presented a special report on the subject. Though not seeing their way to give the London County Council the powers which they asked for, the Committee "consider that the provision of cheap electrical power for London is so important and pressing that they do not view with favour the possibility of the question being indefinitely hung up."

While attention has been concentrated upon electricity as a medium for the supply of light, heat, and power, the claims of gas have been to some extent overlooked, although its field of usefulness coincides very closely with that of electricity.

The late Sir William Siemens used to insist strenuously that gas should be used for all purposes in place of coal, the burning of which in its raw state he denounced as "a barbarous practice." The substitution of gas for coal has been greatly impeded by the circumstance that it was first introduced solely as an illuminant, in which light it is still generally regarded. This conception of gas continues to dominate the methods of manufacture and distribution, to the great detriment of users of heat and power.

The main obstacle to the general use of gas for purposes other than lighting is its cost, which varies from 11d. per 1,000 cubic feet (at Widnes) to upwards of 7s. 6d. The higher prices of gas are due to various causes, the chief of which are the standards of illuminating value to which it has to conform, the large capital involved, the disproportionate cost of manufacture on a small scale, and the high prices paid for coal, consequent on the cost of carriage from the collieries. These causes together swell the cost of the gas consumed in this country every year by many millions of pounds. Illuminating standards are now in many cases being relaxed, but not to such an extent as to give the consumer the full benefit to which he is entitled. The effect of high capital charges and that of working on a small scale are automatically reduced with every increase in consumption, and the greater part of the cost of carrying coal may be saved (in the case of London) by making the gas at the pit's mouth, and piping it, under pressure, to the Metropolis. It is well known among engineers that a pipe line is the cheapest means for transporting anything which can be made to flow. This has long been recognised in the case of water, which no one would think of conveying by rail, except on an emergency, such as recently occurred at Lincoln. Water is piped to Coolgardie, a distance of 352 miles, and pretroleum over 400 miles to New York Harbour. The advantage of generating power at the collieries on a large scale and transmitting it to the areas of supply, has been pointed out by the Royal Commission on Coal Supplies, but in this country proposals of this kind have been directed chiefly to the conveyance of electrical energy from the coal-fields. A proposal to supply the metropolis in this way was laid before the Select Committee, who dismissed it as not suitable.

Gas has many advantages over electricity for transmission purposes. It can be conveyed at less cost and at a much higher efficiency; it can be stored cheaply and without loss, and used at any desired rate, and it requires no conversions, as in the case of high-tension electricity. Moreover, even where electricity is required, it will generally be cheaper to convert the coal into gas and pipe it for use in gas-engines than to generate current direct from coal.

Down to very recently the conveyance of gas under high pressures to long distances would have been regarded as impracticable, owing to various difficulties arising from condensation and leakage and to other considerations. Of late years, however, both natural gas and coal gas have been piped in America to great distances (extending in the case of natural gas to 200 miles) with marked success, and further projects of the kind are under way.

In this country, in the absence of natural gas, either of fuel gas, such as Mond gas or water gas, or coal gas of reduced illuminating power might be used. The latter could probably be sold in London at something like 1s. per thousand cubic feet, at which price it would displace the greater part of the coal now used for heating and power purposes. The larger cities and towns in Lancashire and Yorkshire, and other districts within easy reach of coal fields, might also with advantage lay down pipe-lines of their own, but smaller and more remote places could only do so in combination—preferably through a Board formed on the model of the Metropolitan Water Board—of representatives of the various corporations and companies interested.

The inauguration of a general supply of cheap gas would have far-reaching consequences. The smoke nuisance, with its appalling death-roll, would be done away with, and the annoyance and damage to property from smoky fogs brought to an end. A cheap and abundant supply of sulphate of ammonia would come to the aid of our distressed agricultural interests. The most far-reaching effect of cheap gas, however, would probably be in stimulating the establishment of manufacturing plants in rural districts, thus helping to relieve the congestion in our overcrowded towns. No single factor has played so great a part in determining the distribution of industries as the existence of natural sources of power, and with gas at such prices as it could be supplied at from the collieries, gas-power would be even cheaper than water-power.

Last, but in he long run not least, in importance is the part which the substitution of gas for raw coal would play in postponing the exhaustion of our coal-fields.

HOME INDUSTRIES.

Suburban Railway Traffic and Electrification.—Reference was made in these Notes last week to the coming electrification of railways, beginning of course with suburban traffic. Since then the half-yearly general meeting of the shareholders of the London and North-Western Railway Company has been held when the Chairman, Lord Stalbridge, referring to the serious problem the directors have had before them for some years of how to relieve their main system of some of their present suburban traffic, so as to give increased accommodation to the long distance traffic, and also how to develop properly the suburban traffic without causing much disturbance to Euston station, made an important announcement. He and his co-directors have decided that the solution of the problem is to be found in an electric railway from Euston to Watford and neighbourhood, partly alongside and partly under the company's present main line, with a loop and local station under Euston Station to serve not only the company's existing suburban stations, but several additional stations along the proposed route. By this means the company will be enabled to relieve the main lines of a great deal of their present suburban traffic, improve their service from Watford to Broad-street, and give much needed facilities for their long distance passenger and goods traffic. Also they will be able to give a more frequent service of suburban trains, while decreasing the suburban traffic passing through Euston station.

The Hop Industry.—Not for many years has the outlook for the hop industry been so bad as it is this year. It is believed that the crop will be a smaller one than in 1904, when it was only 282,330 cwts. East Kent and Mid Kent will grow considerably less than in 1904, and Sussex is not expected to grow two-thirds of the 1904 yield. The best portion of the Weald promises well, but the crop as a whole will be much below the average. Moreover the expense of saving the hops has been so great that, if the statements of growers are to be accepted, nothing under £10 per cwt. for the coming crop will show a profit. Assuming that to be an excessive estimate, it is certain that the operations of the season, consequent upon the exceptionally adverse climatic conditions, have been extraordinary costly, and there is little likelihood of prices rising to meet this outlay and compensate, as they not unseldom do in bad seasons, for deficient yield. In 1882, for example, when the outlook was much what it is to-day, so far as the crop is concerned, the quotation rose to £21 2s., but last year the crop was so enormous—695,943 cwts.—that prices may not be affected as they otherwise would have been by the low yield. The result must be disastrous to many growers, and a quickening of the tendency to abandon hop cultivation as too risky. No doubt in some seasons the hop grower makes a very big profit, but, with larger imports from abroad, anything like the repetition of the 1882 prices is not to be expected. Taking one year with another, it may be doubted whether the hop grower gets a return upon his capital that adequately compensates him for the exceptional anxieties inseparable from the cultivation of hops.

Railway Results.—The Home Railway results for the six months ended June 30 show distinct improvement upon those for the corresponding period of 1905. In nearly all cases working expenditure was at a lower ratio, thus enabling a full proportion of any increase in gross receipts to go to net revenue; capital expenditure has been small, and so little of the increased net revenue has been intercepted by heavier prior charges; and the dividend announcements, as a rule, compare favourably with those of 1905. One of the few exceptions is the North London, which has announced a distribution at the rate of $4\frac{1}{2}$ per cent. per annum, in contrast with 5 per cent. a year ago, but the decline in gross receipts is only £1,669, or less than three-quarters of one per cent., the whole of it being due to passenger earnings, which the directors attribute, no doubt correctly, to the competition of motor omnibuses. On the other hand, freight receipts improved £1,631, or 1·7 per cent. There seems to be little likelihood of recovery in passenger earnings until the line is electrified. At present it cannot hope to compete successfully with the electric competition it has to reckon with, and seeing that the London and North-Western Company, which has a large holding in North London stock, is about to deal with some of its suburban traffic by electric traction, the North London will probably follow suit in the not distant future. The dividend of the London and North-Western is at the rate of $5\frac{1}{2}$ per cent. per annum, with £96,114 forward, in contrast with a distribution at the rate of 5 per cent., with £74,494 carried forward last year; the Great Western dividend is unchanged at the rate of $3\frac{3}{4}$ per cent., but its gross earnings increased £135,000, and the balance carried forward is £42,003, as against £28,584 in 1905. Its new capital charges remain heavy, and until these are completed any appreciable improvement in dividends is not likely. The Midland Railway distribution is at the rate of $4\frac{3}{4}$ per cent., as against $4\frac{1}{2}$ per cent. last year, and the carry forward is £23,483, as contrasted with £12,254 a year ago; the Great Northern is unchanged, at 3, but its receipts increased by £113,905; the Lancashire and Yorkshire improved its dividend from at the rate of $3\frac{1}{4}$ per cent. to 4 per cent. The increase in gross receipts was £131,486, and the ratio of working expenses to receipts was reduced from 60·2 to 59·3 per cent., so that a good proportion of the gain in gross revenue became available as net revenue. The North-Eastern dividend is at the rate of $5\frac{1}{4}$ per cent. per annum with £62,000 forward, against $4\frac{3}{4}$ per cent. last year with £41,349 forward. The additional profit earned was equal to an increase of 5-8th per cent. of dividend. The present would seem to be a favourable time for the purchase of stock of the leading railway companies. Quotations have not as

yet improved in proportion to the improvement in the position. North-Eastern stock, with excellent prospects, is at its present price a 4 per cent. investment; London and North-Western still gives a trifle over 4 per cent., and so with Great Western and Midland deferred.

The Brewing Industry.—Within the last few days balance-sheets and statements of accounts have been issued by the two greatest brewery companies in the United Kingdom, perhaps in the world, those of Guinness and Bass. In point of prosperity the companies are similar, in other respects they are strikingly different. Ever since its formation, in 1887, the Guinness Company has published full information as to the course of its business; this is the first year, since its formation in 1888, that Bass has published a balance-sheet. The Guinness Company confines itself to the brewing of stout only; Bass makes ale and sundry other products as well as stout. The Guinness Company has no tied houses; Bass has many. All classes of the Guinness capital is open to the public, and is the same in amount to-day as when the company was formed eighteen years ago; Bass has increased its capital, but none of the ordinary share capital is, or ever has been, in the hands of the public. The prosperity of both companies has been unbroken, and the continuous increase in the Guinness profits is among the most remarkable instances of joint-stock success. For the nine months to June 30, 1887, the ordinary shareholders received a dividend of 14 per cent., for each of the next seven years it was 15 per cent., for the two following years 16 per cent., then 18 per cent., then for three years 19 per cent. each year, while for the years from June 30, 1901 to 1905, the distribution was 20 per cent. For the year ended June 30 last it was 20 per cent. plus a bonus of 2 per cent. In January 1 next, the outstanding £1,500,000 of 5 per cent. Debenture Stock will be paid off, and in place of it there will be an issue of £1,000,000 three and a-half per cent. stock, which will mean a saving of £40,000 per annum, or only £10,000 short of the amount required for a dividend of 2 per cent. on the ordinary stock. It is quite possible, therefore, that this company may pay 25 per cent. in another year or two. Last year, its gross trading profit reached £1,993,544, an increase of £144,609 over that for the year ended June 30th, 1905, and as this increase in profits was accompanied by an increase of only £26,075 in expenses, the net earnings at £993,347, were £118,534 better. Bass's figures are smaller, but they too are impressive. The gross profit on sales, as shown by the profit and loss account, was £821,156, the company's total income being £935,477. The various outgoings amounted to £574,644, leaving a balance of £360,833. After meeting fixed charges, and paying a dividend of 14 per cent. on the ordinary shares, there remains a balance on the year's working of £21,633, which, with the amount brought forward of £7,717, makes a total of £29,350; £20,000 of which is carried to the reserve, which stands at £1,350,000. The profits of the company, though very large, have changed but little since the formation of the company. In its prospectus of 1888, the average annual net profits of the previous five years were stated to have exceeded £340,000 per annum, and for last year they are given as £360,833. Guinness's shows much larger expansion in net earnings which for the year ended June 30th, 1888, the first complete year in the company's history, were £772,800, and last year £992,105.

The Consumption of Alcohol.—For some years past there has been a noticeable decline in the consumption of alcoholic liquors, and opinion has differed sharply as to the cause of it. On the one hand, it has been attributed to a change in the habits of the people, and on the other it has been put rather to contraction in the spending power of the masses than the progress of temperance. Whichever be the true explanation, or whether the decrease is due to both causes, it may be noted that the customs returns for the quarter ended June last indicate that the decline in the consumption of beer and spirits has been arrested. During the quarter the quantity of beer retained for consumption in the United Kingdom amounted to 8,395,286 barrels, compared with 8,377,043 barrels in the corresponding period of 1905 and 8,538,589 barrels in 1904; while the quantity of home-made spirits so retained in the quarter reached 7,481,905 gallons against 7,472,147 gallons in 1905 and 7,718,623 gallons in 1904. The increase in the quantity of foreign spirits retained for home consumption is much more marked, the total for the three months ended June being 1,524,219 gallons as against 1,364,164 gallons and 1,481,762 respectively. The period covered by these figures is much too short to demonstrate that the public demand for alcoholic liquors is rising with improvement in the spending power of the masses, but the figures bearing on this consumption during the remainder of the year will be examined with exceptional interest by those interested in the subject.

British Insurance Offices and the San Francisco Fire.—The Insurance Department of the State of New York recently called for sworn statements of the insurance companies doing business in that State as to their losses from the San Francisco fire, and from the statements so obtained the *Times* has compiled a table of the gross insurances affected, and the losses estimated to have been incurred by the British offices and their subsidiary American companies, arriving at a total of 87,877,698 dols. as the amount of the gross insurance involved, and of 46,125,835 dols. as the actual amount of the loss of the British offices after deducting re-insurances and salvage. These figures can, however, be only taken as approximate, since many claims have yet to be adjudicated upon, and many difficult points to be settled. The British offices, almost without exception, are said to have

intimated to the New York Insurance Department that it is not their intention to draw upon their fire reserves in the United States to pay their losses. Commenting upon this decision, the *Economist* observes that considering their outstanding liabilities in America have been largely curtailed by the San Francisco conflagration, "it might have been thought the companies would utilise some portion of their funds for the purpose of meeting the claims upon them. It was finally decided, however, that in view of the magnitude of these claims, the amount that would be so obtained would be, comparatively speaking, so small that it would not be worth while going through the formalities requisite to obtain the release of the funds which are held by trustees for the company and for the American policy holders."

Foreign Insurance Companies and the State.—It was mentioned in these notes in the *Journal* of July 27th, that the opinion of the majority of the managers of British fire offices is against the proposal to compel foreign insurance companies doing business in this country to make special deposits of funds in Great Britain, and the Report of the Select Committee of the House of Lords now issued confirms that statement. As to the deposit of £20,000 required by the Act of 1870 in the case of life offices, the Committee are in favour of not only maintaining the condition, but of making the deposit a permanent one instead of, as now, withdrawable so soon as the premiums amount to £40,000. The Committee seem to think "it would afford an absolute guarantee to policy holders in foreign companies of being able always to proceed, if necessary, against such companies in the Courts of this country." The Committee insist that the best means of guarding the interests of policy holders in all insurance companies, is by insisting upon the fullest openness in the accounts, and they recommend that all insurance companies, whether British or foreign, shall be required to furnish the Board of Trade with the full revenue accounts, and the valuation statements of their business, showing at the same time the expenses of management.

OBITUARY.

P. V. Ranganatha Rao, B.A., B.L.—Mr. Rao, Registrar and Small Cause Judge in the Pudukotah Native State, South India, died at his residence there on the 25th May last. He was born on the 18th August, 1868, the eldest son of the late A. Venkata Rao, Collector and District Judge of the State, and grandson of the late Raja Sir T. Madhava Rao, K.C.S.I., Prime Minister of Baroda. His family had served the Pudukotah State for more than four centuries, and some of his ancestors gained distinction in the military service of the Nabob of Arcot. He had a distinguished career at college, and was highly esteemed for his learning, and patience as a judge. He was elected a member of the Society of Arts, in 1902.

GENERAL NOTES.

Hayti.—Mr. Consul-General Vansittart's report on the affairs of Hayti (3673, Annual Series) points to a very discouraging outlook in the island. Hayti depends largely upon its coffee crop, and that of 1905 was one of the worst known. The premium on gold throughout the year, ranged between 534 per cent. in January, and 476 per cent. in December, giving an average for the year of 507 per cent., with the result that the prices of merchandise increased considerably, and much poverty and inconvenience followed as a result. In June, a law was promulgated which reduced the interest on the Internal Haytian Government Loans to half the interest they had hitherto been paying, and took away a part of the guarantees specially assigned to the service of these loans without the consent of the creditors. Most of the bonds are said to be held by Germans, Americans, and French. Some railway construction has been commenced, and more is in contemplation, but the work already begun proceeds very slowly. The railway from Gonaives to Hinche will pass through a valuable timber belt of cabinet woods. There are also ebony, rosewood, and cedars in the district, and the route is believed to be rich in minerals. Over 60 per cent. of the total imports to Hayti come from the United States, and are almost wholly made up of provisions. British imports are confined to the cheaper kinds of Manchester cotton goods, and there seems little likelihood of much improvement. The latest religious bulletin of Hayti gives the total population as 1,425,000 souls, the overwhelming proportion of which is black or coloured.

Celluloid.—What Mr. Consul-General Rolfe calls "a kind of celluloid" which is not inflammable, has been patented in Italy by a British inventor, and will probably cause a keen competition with tortoiseshell, the making of which has been largely a monopoly in Naples. Celluloid can be made into combs, hairpins, and other objects closely resembling real tortoiseshell, but hitherto its use involved a certain amount of danger. It is claimed for the new invention that in the most aggravated circumstances it will only carbonise, and not flow like a stream of melting sealing wax setting fire to any inflammable substance that may happen to come in its way. The immunity from taking fire is secured by mixing glue, gum arabic, and colza oil with the original substance when in a liquid state, and purifying it from sediment by various processes, until it becomes perfectly clear, when it can be worked up to resemble any kind of tortoiseshell at a very much lower price.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

SECTIONAL COMMITTEES.

COLONIAL SECTION COMMITTEE.

The following is the list of the Colonial Section Committee, as appointed by the Council:—

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S. Digby (Secretary).

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FIRE, FIRE RISKS AND FIRE PREVENTION.

By Professor Vivian B. Lewes,
Royal Naval College, Greenwich.

Lecture II.—Delivered March 19th, 1906.

The means by which we raise our fuel to the ignition point, and by which we kindle those sources of artificial light that depend for their action upon combustion, must be and always have been amongst the most prolific causes of accidental fire, and taking the six most important manufacturing towns in Great Britain, it is not surprising that in 1904 nearly 1,700 fires were due directly or indirectly to matches.

The match is now so much a part of our civilisation and life, that we fail to recognise what life would be without it.

If we only go back a hundred years we find ourselves in the flint and steel age, condemned to go through life with all the paraphernalia of flint, steel, tinder, and spunk, or else to be dependent upon such chemical curiosities as Chancel's chlorate, sugar, and sulphuric acid matches.

In 1827, John Walker, of Stockton-on-Tees, invented the first English friction matches, to which the name of Lucifer matches or Congreves was given. This match contained no phosphorus, and consisted of a splint of wood tipped with a mixture of antimony sul-

phide, potassium chlorate, gum, and starch, which could be ignited by friction on sand-paper; it was the immediate forerunner of the phosphorus match.

A little doubt exists as to the discoverer of the present phosphorus match as several experimentalists seem to have hit upon a practical method of harnessing the highly inflammable element for use in the match about the year 1833.

Phosphorus itself had been discovered in the seventeenth century, whilst Scheele at the end of the eighteenth century had shown how phosphorus could be cheaply obtained from the calcium phosphate existing in bones. During the forty years after this discovery attempts were made to utilise its low ignition point for obtaining combustion. Indeed, as early as 1816, a friction match tipped with a composition containing phosphorus was manufactured by Derosne, while tubes containing phosphorus fused with sulphur, into which a splint could be dipped, were used in Germany about 1820. These preparations were far too dangerous to achieve any degree of success, and the phosphorus being in a finely divided condition with little or nothing protecting the particles from the action of the air, was far too sensitive and liable to spontaneous ignition to be practically used.

Phosphorus melts at 44° C. (111·2 F.) and ignites at a few degrees higher temperature, its ignition being variously given at from 45° C. (113° F.) to 62° C. (143·6° F.), these discrepancies being due to the rapidity of its oxidation raising its temperature above that of the heating media. Its true igniting point, however, may be taken as being about 60° C. (140° F.).

The discovery which really made the possibility of the phosphorus match was that if a warm solution of glue were taken at 44° C. (111·2° F.), and both the phosphorus and oxidising material were stirred in it, the phosphorus melted and became separated into excessively small particles by the stirring, whilst the oxidising material dissolved. On tipping the match-heads with such a mixture, when dry, the particles of phosphorus were entirely surrounded and protected by a thin film of the glue, and it was not until friction upon a roughened surface in the striking of the match broke down the glue partitions that the phosphorus and oxidising material could act upon each other. The friction at the same time supplied the necessary heat to ignite the phosphorus, which then burnt partly at the expense of the oxygen of the air and partly at the expense of the oxidising material added to the match-head mixture.

As soon as this discovery was made improvements rapidly followed, and the match as we have it to-day is really a beautiful application of scientific facts, based upon the different points of ignition of the materials used for gaining the temperature necessary to ignite the various substances in which we wish to start combustion.

In the match-head we have phosphorus with its ignition point of 60° C. (140° F.), but it is quite clear that this cannot be the temperature at which the match-head inflames, as otherwise a box of matches left in the sun on a hot summer's day would certainly ignite, but it is the temperature of ignition after the protecting film of glue has been broken down, so that on striking the match we really bring this point of ignition into play, whilst with the glue still intact the match-head has to be brought to a temperature of 190° C. (374° F.) before heat alone causes its ignition.

When the match-head is ignited by friction, if the match-head mixture were attached directly to the wood of the match, a very small percentage of the matches themselves would ignite, as although the temperature yielded by the burning head is fairly high, the combustion takes so short a space of time that the wood of the match would not be heated up to the temperature at which it catches fire. For this reason, the earlier forms of matches used to be tipped with sulphur before being tipped with the match-head mixture, as sulphur, having an ignition point of 250° C. (482° F.) was easily ignited by the burning match-head, and carrying on the combustion for a considerable period, raised the wood to its igniting point of 520° C. (968° F).

The smell of the burning sulphur was, however, extremely objectionable, and it was found that the sulphur might, with advantage, be replaced by a paraffin wax, or mixture of paraffin and stearin which, although it has not so low a point of ignition as the sulphur, still is partly vapourised by the combustion of the head, the vapour really catching fire and igniting first the wax and then the wood. Even this slight difference in the ignition point made by substituting hydrocarbons for sulphur is noticeable to the ardent smoker trying to light a pipe on a breezy day. With the old sulphur-tipped match very little shelter from the wind sufficed to enable a light to be obtained, whereas the difficulties are much

increased with the more modern forms of matches.

The number of accidents arising from matches soon began to attract attention, and attempts were made to lessen these dangers. In 1855 Lundström, in Sweden, manufactured safety matches by separating the phosphorus and the oxidising material, and making the match tip of very much the same character as the old Congreve head, whilst the phosphorus was put in the striking composition on the side of the box, the substance being used in its allotropic modification, the not easily inflammable red phosphorus. In some continental works the use of phosphorus in any form has been abandoned, although it is very difficult to get anything like the same certainty of ignition without its aid.

In considering the fire risks due to matches we shall find that they really fall under five distinct heads :—(1) The dangers during manufacture; (2) The dangers during storage and carriage ; (3) The flying off of an ignited head, or breaking off the unignited head during the striking ; (4) The improper use of matches, such as their use as playthings by children ; (5) The after results, such as matches thrown down whilst alight, the glowing of the stick after use, and the falling off of the red-hot head, &c., this latter class of risk being undoubtedly the most prolific in causing accidental fires.

In the process of match-making the dangers of ignition are undoubtedly very considerable, and especially in the halving and boxing of the matches frequent firing takes place, but all these risks are so well known and amply provided for in the equipment of a match factory that the risk of any large conflagration or loss of life is, if anything, less than with manufactures considered perfectly safe.

During transit and storage the dangers to be faced are friction set up in badly-packed boxes, and sudden shock, such as dropping a case of matches into the hold of a vessel (and this also must be guarded against in storage), plenty of well authenticated cases are known of fire being caused by the accidental knocking of a packet of matches off a shelf, or even the fall of a single box. A more subtle cause of danger comes into play if in the perishing of the glue in the match-head, some of the finely divided phosphorus is exposed to the action of air, as owing to the large surface then exposed oxidation becomes very rapid, and spontaneous ignition results in a few minutes ; cases of this, however, are rare, for if the glue is good no perishing is likely to take place.

Everyone knows the danger that exists with cheap matches caused by the flying off of a portion of the ignited head. This often inflicts a painful burn, and in some cases starts slow smouldering combustion in some article of clothing. The chief cause of this is made manifest when one examines a match-head. It will be seen that instead of a nicely rounded nodular head, it is thick at the sides, and the square wood of the stick almost shows itself through the match-head. As these are struck the thick portions at the side of the stick detach themselves and fly off. This malformation is brought about in the manufacture by not allowing sufficient time for the matches to dry head downwards after dipping in the match-head mixture, as is done in the better class of matches. If the bundle, after being dipped, is turned over too soon the mixture has a tendency to run down on to the stick and so spoil the shape of the head.

Further causes for the flying off of the match-head are also to be found in the use of potassium chlorate in rather too large a quantity in some match-head mixtures, too rough a striking surface, and too great vigour in striking.

Another danger of the same class with matches is the breaking off of the head before ignition, or the dropping of unignited matches in a room. The match-head when trodden on usually ignites with almost explosive violence, the rapid action of the oxidising agent being then rather a safeguard.

The after results of the use of matches are perhaps the gravest source of danger, and are partly due to sheer carelessness and partly to the matches themselves. One sees every day in the street lighted matches being thrown down with the utmost disregard to the safety of property and passers-by, the offender in many cases relying upon a short wave of the match in the air to extinguish it and not looking to see if extinction really occurs. With some matches, again the stick remains glowing for a minute or more after the flame has been extinguished, this continued glowing of the stick being of course due to the rapid form of slow combustion which we call "smouldering" taking place owing to the contact with the oxygen of the air, and in some cases this is very marked. There is one capital brand of match of which I am very fond and much prefer to wax vestas for lighting pipes and cigars. For this purpose it fully deserves the title under which it is advertised—the ideal

smoker's match, but it is one of the worst offenders for smouldering that I have ever come across, as nine matches out of every ten, after being ignited and used, smoulder until the head falls off, carrying with it a still smouldering piece of the splint. I have, more than once, set my waste-paper basket on fire by them, and on many occasions have only just been in time to stop ignition.

This trouble, however, can easily and readily be got over by soaking the wood, of which the matches are made, in solutions of such salts as ammonium phosphate, boracic acid, or other well-known "antipyrenes."

With the exception of those dangers due to absolutely inexcusable carelessness the danger of the match can easily be got over by using nothing but safety matches. When this class of match was first introduced many brands of them were very nearly perfect, striking only on the prepared surface of the box, having well shaped heads which were not liable to fly off or fall off, and prepared stems which did not glow after the flame had been put out, but most of the safety matches that one gets to-day have the sensitiveness of the head slightly increased, so that they can be struck on a sufficiently large glass or smooth paper surface, the effort to do so, however, being so considerable that the safety is but little impaired. When using these matches it must be remembered that the box itself must be kept from contact with oxidising materials like potassium chlorate, as a good many accidents have happened from contact between a potassium chlorate throat lozenge and a safety-match box in the same pocket.

This arises from the fact that in the head of the safety-match there is a mixture of chlorate of potassium with sulphide of antimony and glue, whilst the striking mixture on the box consists of a mixture of red amorphous phosphorus, sulphide of antimony, and glue. When the match is lightly rubbed on the box the glue walls are broken down, and the phosphorus and oxidising chlorate come in contact, giving a sufficiently high temperature in their combination to cause the sulphide of antimony in the match-head to burn at the expense of the oxygen of the chlorate. When, however, the chlorate is used as a lozenge or tablet it is generally mixed with sugar, and the heat of the combination between the chlorate and the phosphorus on the box causes the sugar, which is a compound rich in carbon and hydrogen, to burn at the expense of the oxygen of the chlorate.

We have seen that it is oxygen that supports the ordinary forms of combustion; such bodies as the chlorate or nitrate of potassium contain 600 times their own volume of oxygen, and as air is roughly one-fifth oxygen, a cubic inch of these salts is equal, in its oxidising power, to 3,000 cubic inches of air.

Chlorate of potassium has been almost universally used in England as the oxidising material in match-making, and although very satisfactory in ensuring the burning of the match-head, yet it is so vigorous in its action, owing to its being an endothermic compound, that the matches sometimes ignite with almost explosive violence, which adds to the danger of portions of the ignited head flying off, whilst they nearly always explode when trodden upon on a hard surface. To overcome this trouble many foreign-made matches contain nitrate of potassium or the higher oxides of lead or manganese as the oxygen carriers, such matches igniting silently and rarely catching fire from accidental causes.

The large class of fire risks due to matches would nearly be eliminated if nothing but well-made safety matches with non-glowing stems were used, and the price at which these can now be obtained would make it no great hardship if the use of ordinary phosphorus matches were prohibited, as is done in several European countries. Such a measure would be all the more welcome, as the use of red phosphorus only would enormously lessen the risk of the painful disease of the bones of the face to which workers with yellow phosphorus are liable.

Having reached the ignition point of the wooden splint of the match by three stages, the temperatures representing the ignition point of the head, the intermediate coating, and the wood, the combustion of such material as coal can then be obtained by having recourse to the ease of ignition which is given by fine division of a mass. We know by experience that if we apply a match direct to a stick of wood, although the temperature of the flame is far above the ignition point of the wood, the mass of the stick so distributes the heat that the ignition point is not reached, and this is the case even to a greater degree with a lump of coal, whilst a piece of paper is rapidly and quickly ignited by means of the match flame.

Now paper and wood both have as their chief constituent the compound of carbon, hydrogen, and oxygen that we know as cellulose, in paper this material being diluted with various substances added as loading and to

give surface, whilst in the wood it contains bodies that were originally present in the sap and a certain amount of moisture. The igniting point of both is, however, nearly the same, the paper having an ignition point of 470° C. (876° F.), whilst the bundle of wood placed near the side of the stove to dry overnight ignites at from 500 to 520° C. (932-968° F.). When the match is applied to the paper the latter rapidly ignites, burning for a sufficient length of time to reach the ignition point of the wood, and this again burning for a considerable time heats the coal up until sufficient of the mass has been raised to the ignition point to ensure its combustion.

Next to matches as a cause of accidental fire comes the firing of woodwork by faults in flues or overheating in the vicinity of the fireplace. One would imagine that such a thing as building a beam into a chimney, or laying a joist close under the hearth of a firegrate would be so manifest a danger as to ensure its never occurring, but such criminal carelessness is by no means so uncommon as one might imagine, and in such cases it is only a question of time and chance for a fire to be caused by it.

A beam, the end of which impinges on the interior of a flue, may be so far above the grate that for years no trouble arises, but the hot upcurrent of gases in the chimney will gradually dry and carbonise the wood, whilst any collection of soot in the chimney catching fire will start a smouldering combustion in the beam that may go on for a considerable time before it gets sufficient air to cause it to break into active combustion.

A more usual source of danger is to be found in the perishing of the mortar used in building the flue, and so leaving gaps in the brickwork behind which the woodwork is situated. Mortar practically consists of a mixture of slaked lime and sharp sand, and when brickwork has been laid with this, the first hardening of the mortar is dependent upon the slaked lime absorbing carbon dioxide from the air, which converts it into carbonate and causes it to harden, whilst after the lapse of many years a further action takes place by the silica of the sand acting on the calcium carbonate to form a silicate of great hardness and strength. With modern buildings, however, the first action is the only one that has taken place.

The brickwork in the interior of a flue is often very roughly laid, being out of sight, and the bricks, instead of being laid true and nearly touching, are made up with broken bricks and a considerable quantity of mortar. After this has set the action of heat upon it is again to burn the calcium carbonate back to lime, so causing the crumbling down of the mortar, and should a joist have been built in close to the casing of the flue, hot gases will find their way through the perished mortar to it, and gradually bring about slight carbonisation of the wood, and occasionally cause its ignition.

Another fruitful source of danger is to be found in the replacement of one form of grate or fireplace by a new one. For instance, a grate is getting rather old, and you determine to have it replaced by one of modern construction, say one of the well fires. In the old grate the hearthstone was flush with the floor, and under this was a sufficient mass of concrete or mortar amply to protect the joists below from undue heat. You probably buy a new grate from a local ironmonger and entrust him with the job of fixing it, and the old hearthstone and insulating material having been removed to make way for the entirely different structure the inexperienced workman fails properly to insulate the bottom of the well-grate, with the result that the joists below get overheated.

Dangers of these characters can only be got over by strict supervision during the building of a house, and by entrusting alterations and repairs only to workmen who thoroughly understand the work which has to be done.

All heating dangers are largely increased, and indeed chiefly exist from the fact that lightly-charred wood becomes almost pyrophoric in its character, and can readily be set on fire at temperatures considerably below those needed to start the combustion of either uncharred wood or charcoal. The changes taking place in wood under the influence of long continued heating are of a complex and interesting character.

Wood consists mainly of a definite chemical compound called cellulose, a body formed from carbon, hydrogen, and oxygen, and besides cellulose we find wood contains the constituents of the sap and a varying quantity o water. The amount of water present depends upon the season of the year and the portion of the tree from which it is taken, whilst the percentage is as a rule greater in soft than in hard woods, the following Table giving an idea of the quantity present in various kinds of wood :—

Beech	18·6 per cent.
Oak	34·7 ,,
Common Fir	32·7 ,,
Alder	41·6 ,,
Elm	44·5 ,,
Poplar	50·6 ,,

When wood is placed under cover and exposed to the air for about a year the moisture is reduced to about 20 per cent., and the remaining moisture can be got rid of by subjecting the wood to the action of heat, the last portions requiring a temperature sufficient to char the wood. If, however, the wood be heated somewhat below this point the greater part of the moisture is removed, but on again allowing the wood to cool to atmospheric temperatures and exposing it to the air, the hygroscopic nature of the wood gradually attracts moisture until the percentage reaches about 20, at which point a sort of equilibrium is established between the moisture in the air and the wood.

When wood is exposed to the long continued action of heat it undergoes progressive changes nearly akin to those which have taken place during the conversion of vegetation into coal. Up to 100° C. (212° F.) practically only moisture is expelled from the wood, and at a few degrees above this point not only water but volatile hydrocarbons are slowly driven out, whilst at 150° C. (302° F.) oxides of carbon, together with more hydrocarbons, are disengaged, and slightly above this temperature the wood commences to assume a scorched appearance, and to turn brown. At about 250°C. (482° F.) wood is converted into a soft brownish form of charcoal, which is its most dangerous form, being highly pyrophoric and self-igniting at comparatively low temperatures. At 300°C. (572° F.) the carbon begins to assume the appearance of soft black charcoal, getting harder and more metallic in its properties as the temperature increases.

The chemical changes which are taking place in the charcoal at these varying temperatures are strictly shown by the following Table :—

Temperature.	Carbon.	Hydrogen.	Oxygen.	Ash.
270° C.	71·0	4·60	23·00	1·40
363° C.	80·1	3·71	14·55	1·64
476° C.	85·8	3·13	9·47	1 60
519° C.	86·2	3·11	9·11	1·58

It is seen that as soon as 270° C. is reached the action consists in a gradual increase in the percentage of carbon, owing to the elimination of hydrogen and oxygen, and it is clearly due, therefore, to compounds still containing these three elements in comparatively large proportions that the pyrophoric carbon owes its dangerous character. If the contact of the wood with the heated surface be continued for a sufficiently long period of time, a temperature of a few degrees only above the boiling point of water is enough to produce a semi-carbonised film on the wood, which will start smouldering at a very low temperature, the heat rising from an oil lamp or gas flame some distance away being sufficient to start the smouldering combustion. Indeed, the temperature of a steam-pipe has been found sufficient to cause ignition, this being due probably to the long continued heat generating certain hydrocarbons of low ignition point, which remain occluded in the pores of the semi-charred wood, and are there brought into close contact with the occluded oxygen.

It must be remembered that when using steam heating, although the boiling point of water at ordinary atmospheric pressure is only 100° C. (212° F.) yet the boiling point rapidly increases with increase of pressure, as is shown by the following Table :—

Pressure in atmospheres.	Boiling point. ° C.	Pressure in atmospheres.	Boiling point. ° C.
1	100	12	190·0
1·5	112·2	14	197·2
2	121·4	16	203·6
3	135·1	18	209·4
4	145·4	20	214·7
5	153·1	25	226·3
6	160·2	30	236·2
7	166·5	35	244·8
8	172·1	40	252·5
10	181·6	45	265·9

So that in lofty buildings heated either by water or steam it is quite possible to obtain temperatures which will dangerously char wood in contact with the pipes, whilst with air as the heating medium it is by no means uncommon to find a dull red heat in the pipes and flues near the furnace. Nor does the danger cease when care is taken that the pipes or flues used for these methods of heating are kept several inches away from any woodwork, as in inaccessible places the accumulation of dust on the pipes often gives rise to trouble.

When a hot-water or steam-pipe is laid alongside a wall, it will be noticed that where a flange or other projection of a pipe touches the wall there is a brown stain produced on the wall surface streaming upwards from the point of contact and becoming less the further away it gets from the place where it starts.

Experiment shows that this is due to dust settling on the pipe becoming carbonised and ascending with the hot-air current produced by the pipe; this current comes in contact with the surface of the wall, and the hot gases rapidly diffusing through, the charred particles are filtered off, remain on the surface of the wall, and give the stain. When, however, the accumulation of dust is large, the carbonised mass being in a very loose state of aggregation and made up of very minute particles, will often start glowing with a very slight increase of temperature above the ordinary temperature of the pipe.

The fire risks due to lighting are of a most varied character, even daylight itself not being free from danger, hundreds of fires having been caused by the accidental focussing of the sun's rays by means of a full water bottle, irregularities in the window pane or other cause, which has led to the concentration of the sun's rays upon some inflammable substance.

Turning to artificial illumination, the great risk attending the use of a candle is that which is found with every moveable source of light, *i.e.*, it may be placed in such a position that the flame can heat some inflammable substance, as when pushed under a projecting shelf or placed on a toilette table in such a position that the draperies or curtains can be blown in contact with it. In the old days when the wicks of candles were constructed of bundles of cotton strands, the dangers attending its use were much more formidable than now, as sparks were very often given off during the snuffing of the candle, whilst the portion removed by the snuffers would glow for some time after, but this is now a thing of the past.

With gas lighting the dangers due to moving about a small unit are wanting, but swinging and even fixed gas brackets placed between windows where they are liable to come in contact with the curtains or other drapery still remain a grave source of risk, whilst to the ordinary fire risks is now to be added explosion risk. Sliding chandeliers are responsible for a large number of explosions owing to the evaporation of the water which forms the seal, or to the hardening of the packing which serves to keep the sliding tube gas-tight, the result of which is that the gas escapes without any previous warning, and this is liable to happen at any time.

Leaking of gas into the air of a room may also be brought about by faulty fittings, the driving of a nail through a compo gas-pipe, the extinction of a small flame, such as that of a bye-pass, by reduction of pressure in the mains, the turning off the gas at the meter at night whilst a burner is still on and the discovery of the fact after the meter is again turned on, and many other causes.

When coal-gas is lighted as it issues from the mouth of the burner it burns quietly, sorting from the air the oxygen it needs for its combustion, but if from any accidental cause the gas leaks into the air of a room, when a certain proportion is reached, an explosive mixture is formed, and contact with a lighted fire or taper at once produces explosion. The rate at which flame is propagated through mixed gases is dependent upon the proportion in which they are mixed, a mixture of air and gas being only explosive between the limits of 8 and 29 per cent. of gas in the mixture.

The lower proportion of inflammable gas represents the smallest quantity which when mixed with air will burn rapidly, and so in large volumes produce explosion, whilst when the amount of gas rises above the upper limit the gas will only burn where it is in contact with an additional supply of air, and does not explode, and it is only over a still shorter range that the explosion reaches its maximum power.

The risk of explosion from coal-gas would be reduced to a minimum if only people could be induced to forego the luxury of searching for the leak with a lighted taper, or at any rate deferring the pleasure until open windows and doors had removed most of the smell of gas from the room.

Taking the fire returns as they stand for the year 1904, it might be imagined that the risks attached to oil as an illuminant were less than those appertaining to the use of coal-gas, but this is not the case, as if the proportion of risks per unit of light developed were taken, the risks for an equal amount of light from oil is found to be enormously greater, whilst the average would have to be taken over many years instead of over one, to present anything like a fair comparison.

Up to 1852 there was practically but one kind of oil lamp the use of which was fraught with any danger. In the ordinary domestic lamp, oils of animal or vegetable origin, like sperm and colza, were employed, and owing to their comparatively high point of ignition and freedom from inflammable vapours, these offered but little danger, but when coal-gas first began to be introduced on a large scale, and attention was paid to recovering the bye-

products from tar, the first distillate, consisting largely of benzene, was sold under the name of benzoline or tar spirit, for use in outdoor flare lamps, in which the spirit enclosed in a conical reservoir passed a few drops at a time down a long capillary tube to a rose head, which having been heated by holding a burning newspaper under it, vaporised the benzene in the hollow head, and created sufficient pressure to drive the gas out through the holes in the rose burner in such a way as to give a very satisfactory though occasionally smoky flame. These lamps were the most popular form of illumination amongst hawkers and travelling showmen, whilst the same liquid was also employed in small sponge lamps for use in the house, a sponge being soaked with the spirit in a small reservoir, this spirit being sucked up by the wick to a small tube burner.

The dangers attending these lamps were very much of the character of those found at the present time with mineral petroleum spirit or petrol. They give off inflammable vapour even below the freezing point, and unless most carefully stored, the escape of the liquid in the form of a heavy vapour gives not only explosive mixtures with air, but also causes ignition of the vapour at a very great distance from the liquid, from the flame flashing back to the liquid itself.

In discussing the question of the dangers of oil lighting it will be well for a moment to consider upon what these depend. When, in 1847, James Young first discovered mineral oil exuding from a shale measure at a colliery near Alfreton, he used it merely as a lubricant, distilling off the lighter portions and using the heavy residue as a machinery oil. Failing in his early endeavours to utilise the distillate as lamp-oil, this portion was practically wasted or sold at a very low rate, but a few years later, when making the oil on a large scale by the distillation of shale in Scotland, he noticed that the distillates were being bought up and exported to Germany. On tracing the oil he found it was being used in Berlin in lamps of a peculiar construction for illuminating purposes, and this led to the introduction of lamps of the same character in England, and when in 1859 the discovery of mineral oil on a large scale in America took place, the mineral oil-lamp became firmly established.

The dangers for which the ordinary domestic lamp is responsible are due to two sets of causes, in the first place to the character of the lamp, and to the flimsy construction of the cheap lamps sold in poor neighbourhoods, whilst the second class of danger is dependent upon the oil itself.

When the oil comes from the well it consists of a mixture of a large number of different hydrocarbons, some of them, like petrol or petroleum spirit, being excessively volatile and giving off inflammable vapour well below the ordinary air temperature, whilst others, again, have to be heated to a certain temperature before any inflammable vapour is developed. The temperature at which such vapour comes off is termed its flash point, whilst the firing or ignition point of the oil is generally well above this. It is the flash point, however, which is the factor of danger, as if it be too low, vapours capable of yielding explosive mixtures with air are given off and are liable to cause very serious trouble. From time to time legal enactments have been made regulating the flash points of the oils to be used as domestic illuminants, and in 1868 the flash point was prescribed at 100° F., the test being made by gently warming the oil in an open cup until by passing a very small flame over the surface a flicker or flash was produced, the temperature at which this occurred being the flash point.

It was, found, however, that this method of testing gave rise to many discrepancies, and after many experiments an improved form of apparatus and method of testing, known as the Abel test, was legalised in 1879. In this the flash point is taken in a closed instead of an open vessel, and the process of testing is reduced to a well defined method which eliminates most of the discrepancies before found, but under these conditions the oil which before flashed at 100° F. now gave its flash point at 73° F., and in order not to interfere with the oil industry the legal flash point was reduced when this method of testing was employed to 73° F., instead of as before 100° F., but the oil really was the same.

Much stress has been laid upon the importance of increasing the flash point to 100° F. by the Abel test as being likely to minimise the dangers accruing from the use of mineral oil, but such high authorities as the late Sir Frederick Abel and Sir Boverton Redwood agree in the opinion that the extra heat generated during the combustion of a high flash point oil entirely overshadows any diminution of danger appertaining to its use.

It it were possible to prevent the sale of cheap and dangerous oil lamps, and one could at the same time do away with side

feeds and glass reservoirs to lamps, half the total number of fires and accidents caused by oil lamps would disappear. If people could be persuaded to keep a lighted lamp on a firm table and never to move it, another large diminution in the trouble would take place. The use of lamps with proper extinguishing apparatus, or if these are absent the putting out of the lamp by puffing across the top of the chimney when the lamp had been turned down a little instead of blowing down the chimney, would further diminish the risk of accidents to a point where they would not be much greater than with other illuminants.

Oil-lamp risks and their prevention have been so often and ably dealt with that it is hardly necessary to say more. If a properly constructed lamp with a soft well-fitting wick, is filled full each day so that it is never allowed to burn too low, the oil-lamp is a most excellent form of illumination where coal-gas is not available.

The introduction of petrol for motive-power and its enormous use at the present time in the motor-car and oil-engine have brought into prominence the grave dangers inseparable from the use of this highly inflammable and volatile liquid, dangers which will be dealt with in the next lecture under the heading of storage risks.

Electricity has been responsible for many disastrous fires. Although one might consider it to be the safest form of illumination, as there is no inflammable liquid to spill or gas to form explosive mixtures with air, yet defective cables and fittings have been a fruitful source of accidents. An excess of current may cause a leak in a weak point of a cable, and the short circuiting causing heat, the bituminous envelope of the cable is decomposed with the evolution of inflammable gases which, ignite by the spark and produce flame. A spark from the carbon of an arc lamp falling on inflammable material will start a conflagration, and many fires have been traced to the bulb of an incandescent electric light having been laid on textile fabrics, &c. In the last case the fabric soon begins to char, and in a very short time bursts into flame.

POST-OFFICE SAVINGS BANK.

In his 1905 report on the Post-office the Postmaster-General referred to the change by which the withdrawal without notice of sums not exceeding £1 was sanctioned, but as it did not come into force till after the period covered by the report he was of course unable to refer to results. In his 1906 report he is able to say that "this system, obviating as it does the delay involved in reference to headquarters, and the expense to the depositor of telegraphing if the money is urgently required, achieved immediately great popularity, and has undoubtedly met a great public need." The system did not come into force until 3rd July, 1905, yet the number of "withdrawals on demand" made during 1905 was nearly 2,000,000 and formed 48 per cent. of whole number of withdrawals, the number of telegraphic withdrawals having fallen to about one-half of its former amount. "There can be no doubt" says the Postmaster-General, "that the new facilities have added to the popularity of the Savings Bank and have been a contributory cause of the growth to which reference has been made above." That growth was marked. It may be convenient to give the figures for the last three years:—

	Deposits. £.	Withdrawals. £.
1903	40,857,206	42,786,025
1904	40,612,967	41,904,392
1905	42,300,617	42,096,037

The deposits for 1905, instead of showing a decrease as in the two previous years, show an increase of nearly £1,700,000, and exceed the total amount of the withdrawals by over £200,000. In 1904 the withdrawals exceeded the deposits by £1,290,000, so that the year under review shows an improvement of nearly £1,500,000 on the previous year, an improvement no doubt partly due to trade, but also as the Postmaster-General concludes, "largely attributable to the impetus given to Savings Bank business by the system of withdrawals on demand introduced last year."

It is the common assumption that the people of the United Kingdom are not thrifty, and that in no part of the United Kingdom is thrift so general as in Scotland. Those who dissent from these conclusions may be expected to point to the following figures, submitted by the Postmaster-General, which give the total number of accounts on the 31st December 1905, their distribution, the average amount of each, and the proportion of deposits to population:—

	Number of depositors.	Average amount to credit of each depositor.	Proportion of depositors to population.
England and Wales	9,027,112	15 0 7	1 in 3·8
Scotland	451,627	13 14 1	1 in 10·4
Ireland	484,310	21 2 9	1 in 9·1
United Kingdom	9,963,049	15 5 4	1 in 4·3

Ireland is the poorest section of the United Kingdom, yet the number of depositors is larger than in Scotland, and the average of individual deposits is very much larger. This, of course, is not conclusive as to the saving characteristics, or the surplus, of different parts of the United Kingdom; it only indicates them so far as savings' bank deposits can, but the figures are nevertheless noteworthy. And those for England and Wales are remarkable, showing as they do that 1 in every 3·8 of the population of the country has a savings' bank account.

FRENCH COLONISATION IN ALGERIA.

The extent of the French colonial domain, the greater part of which has been acquired within the memory of the present generation, does not appear to be fully realised. Still less is known of the organisation of these regions, which has been pushed forward systematically since their acquisition, and always with the fixed purpose of assuring the economic future of the French people. A public authority recently remarked that the period of the acquisition of the French domain constituted the heroic age, and that it belonged to the present and to future generations to develop tranquilly and methodically the vast territory under French control. The Colonial Exposition which was opened at Marseilles in April last is a revelation of the accomplishments in the French colonies, frequently secured under climatic conditions least favourable to European development. According to the American Consul-General at Marseilles, this exposition is the first carefully co-ordinated manifestation of the results of French colonial effort, and it is a refutation in itself of the often expressed conviction that the Latin countries cannot successfully colonise. Wherever the Frenchman has gone, within the last forty years, he has taken his engineers, he has built highways for all time, he has classified with patient minuteness the resources of the soil, he has built or projected railways, and he has laid down the general lines for a proper development of the bounties of nature. Algeria is the greatest of all the French colonies, and it is situated directly opposite the coast of France, a day's journey by sea from Marseilles or Port Vendres. Of all the European nations, France alone possesses a colony so near, and so easy of access. The colonisable portion of Algeria is almost equal in extent to the whole of France. On the one hand it is more mountainous and less evenly watered, which reduces the area available for exploitation, and on the other hand its conquest only dates back some forty years. These facts explain why the native population, although almost doubled in thirty years, does not exceed 4,000,000, and why, in spite of the great facilities for visiting the country, the white race numbers only 600,000 persons, of whom rather more than half are French. The colony is capable of sustaining a much larger number. Algeria's economic equipment is important, and is daily being perfected. There are 18,641 miles of national roads and other highways and routes. In the interior, more than 16,766 miles of conducting wires and nearly 600 offices are devoted to the postal, telegraph, and telephone services. By the co-operation of railway and steamer from four to six French mails weekly are possible throughout almost the whole colony. The postal, telegraphic, and telephonic rates are identical with those in France. All the centres are provided with schools. The fiscal burdens are appreciably less heavy than in France. Unbuilt property is free from taxation, as are also doors and windows; registration and stamp duties are lighter, and no monopoly exists of matches or tobacco. Algeria is essentially an agricultural country. The vine constitutes, more particularly in the department of Algiers, the favourite article of culture of the colonists. Cereals predominate in the departments of Constantine and Oran. In the whole of Algeria they occupy over 7,000,000 acres, producing, on an average, over 70,000,000 bushels, representing an approximate value of about £12,000,000 sterling. The cultivation of fruit trees is susceptible of an enormous development; among these the olive trees take a foremost place, those in actual bearing exceeding 6,000,000 in number, and yielding, approximately, 40,000,000 gallons of oil, with an average value of over £1,250,000 sterling. The plantations of fig trees have of late years assumed considerable proportions. The exports of figs from Algeria amounting in 1902, the latest year for which the data are available, to nearly £26,000,000. Stock farming also constitutes an important resource of the colony, the annual exportation to France, of sheep alone, amounting to 1,500,000 in number. With a view to completing the population of the colony by the French, the authorities annually select various districts which they connect by highways with the neighbouring centres. To these districts they bring the water necessary for needs of the inhabitants and for irrigation. They also cause to be built the public buildings essential to a village, and provide the administrative, educational, and medical services. The region is divided into a certain number of concessions which comprise a building lot in the interior of the village, and one or more lots devoted to the kinds of culture suitable to the district. The total area of the concession varies, according to the locality, between 100 and 200 acres, and even more, when it may be deemed necessary. The concessions are allotted gratuitously, subject to the following conditions:—Applicants for concessions must be of French nationality; have a knowledge of agricultural matters; be in possession of sufficient funds for the working of the concession, and agree to reside for ten years on the land granted, subject to the following restrictions and conditions of forfeiture and cancellation:—He shall transport his household, and reside upon the concession with his family in an effective and permanent manner during the space of ten years from the date of taking possession; he shall take possession within six months from the date of his admission, and construct the necessary dwellings and buildings. Furthermore, the Government offer to French capitalists certain lands particularly rich, or bordering on regions already settled. These lands are allotted in estates of varying extent, proportioned to the means of the applicants, but sufficient to assure a good annual revenue. There exist also, in the centres of colonisation, industrial groups, comprising a town lot, and a garden or small culture lot, varying in area from a few square yards to five acres. These groups are mostly sold privately, with an obligation to build thereon. Finally, in the

villages upon the sea coast, or in the most picturesque or mountainous districts there have been reserved a number of lots, suitable for the establishment of summer resorts, for sale on special terms.

AFFORESTATION IN WEI-HAI-WEI.

It will surprise many to learn that the Government have been carrying on a series of experiments in fruit growing and afforestation in Wei-hai-wei. Mr. Gibbons, an expert fruit grower, was sent out at the beginning of last year, and he has no doubt whatever that fruit culture at Weihaiwei, conducted on proper lines, should prove very successful. The climate is much in its favour. Frost ends completely some time prior to the blooming period, the air is dry, and there are no spells of cold, heavy rains to damage the bloom and prevent a set of the fruit. All the deciduous fruits and vines, writes Mr. Commissioner Lockhart in his report (Cd. 2684), flourish. The Chinese of the vicinity have hitherto grown chiefly apricots, pears, and vines. The apricots and pears are poor, common varieties, but the cropping capabilities of the trees afford evidence of what the better kinds may be expected to do. Fruit trees of numerous varieties were obtained from England, and arrived early in April, 1905. They had grown somewhat on the journey, which had sapped their vitality to a certain extent, but notwithstanding this drawback, and the dry winds and hot suns experienced before the rainy season commenced, the trees, as a whole, did well. The apples and pears nearly all survived, and all the other kinds of trees, such as cherries, plums, peaches, and nectarines that established themselves have made a satisfactory growth and look very promising. It is hoped that when the Government has demonstrated, by the experiments now being made with fruit trees of various kinds, that Wei-hai-wei is a favourable centre for growing fruit, private enterprise will be encouraged to establish a trade in fruit. It should find a ready sale in Shanghai and other neighbouring ports.

Various kinds of trees and shrubs were obtained last year from Japan to test their value for Wei-hai-wei. Some of them promise well, others not; but it is too early as yet, Mr. Lockhart says, to form a decided opinion as to the merits of each particular kind. Pine seeds to raise trees for covering the hills were sown on the island, and have proved a success; but at Port Edward seeds of the same kind sown in a sheltered valley, after having germinated well, were nearly all destroyed by the hot, dry, south winds in May and June. A much larger number of pine seeds are being sown this year. The hardier kinds of evergreens and shrubs, so far as they have been tried, have proved quite hardy, but the foliage of most of them becomes much browned by the cold winds by the time mid-winter has arrived. This remark also applies to the native cyprus, which grows into a large tree, and to a larger extent to the fir trees on the hills. The Commissioner thinks it "fairly safe" to assume that all deciduous trees and shrubs, and herbaceous flowers which are quite hardy in England will flourish equally in Wei-hai-wei, and many kinds of annuals do exceedingly well.

The Wei-hai-wei experiments in fruit growing and afforestation might very usefully be copied in some other colonies.

CURIOSITIES OF CUTCH.

Amongst the many curious and complex questions which come before the Law Courts, was one, which some time since, occupied the attention of the Court of Appeal, and which will have a peculiar interest to those whose tastes lead them to the consideration of plant products, and more especially to such as have also a leaning towards antiquities.

To explain, it will be necessary to quote the facts of the case as reported in the daily press. The question was as to the validity of a custom said to have prevailed in the parish of Walmer, in Kent, for the inhabitants, being fishermen, to spread their nets to dry on a piece of ground, called the "beach ground," of about eleven acres in extent, covered with shingle, near the sea. The fishermen claimed this right by virtue of an immemorial custom, and the application was for an injunction to restrain the owner of the ground from building upon it.

The part of the case in which the interest chiefly lies, is described in the following notes from the legal report. It seems that the fishermen down to twenty-five or thirty-five years ago, used to tan or cutch (*i.e.*, preserve by means of an astringent plant imported from the Malay Archipelago), their nets immediately before the commencement of the mackerel and herring fisheries, and dried them on the beach ground. At the period named, the practice of tanning or cutching nets was discontinued, and instead of it the nets were oiled and dried on the beach. The nets take longer to dry when oiled than when tanned or cutched. The change was probably due to cotton being used instead of flax or hemp as the material of which the nets are made. The claims of the fishermen were disputed on two grounds: First, although it was admitted that a custom for fishermen to dry nets that had become wetted by the sea in fishing, was good, it was contended that there could not be a valid custom to dry nets wetted by tanning, cutching, or oiling, inasmuch as these are comparatively modern processes, and a custom must date from the beginning of the reign of Richard I., A.D. 1189. This contention was over-ruled, the Judge remarking that the ground upon which a custom to dry nets in the strict sense had been upheld was, that it was in favour of commerce and navigation. Tanning, cutching, or oiling nets tended

to preserve them and to make them useful for a longer period, and the fishermen ought not to be deprived of the custom simply because they had taken advantage of modern inventions or new operations which did not throw an unreasonable burden on the landowner. The second objection was that in consequence of the receding of the sea in the neighbourhood during the last fifty or sixty years, and that as custom is a local law, which must have existed from time immemorial, it cannot be applicable to land which can be shown to have emerged from the sea in modern times. This contention was also overruled on the ground that even if the sea had gradually and continuously receded, "that which cannot be perceived in its progress is taken to be as if it had never existed at all." In the view of the law, therefore, this was the same piece of land as that affected in the time of Richard I. The Walmer fishermen thus secured their right to dry their nets upon the beach ground, and an injunction was granted restraining the owner of the ground from building upon it.

All this, though very technical, is of considerable interest, when taken in connection with the history of cutch, or, as it is sometimes called, catechu. Cutch, as most people know, is the produce of *Acacia Catechu*, a large leguminous tree belonging to that section of the order known as *Mimoseæ*. It is common in most parts of India and Burma, extending westward to the Indus and eastward to Sikkim, and ascending to an altitude of 5,000 ft. The trees grow to a very large size, 70 ft. to 80 ft. in height, with a girth of from 8 ft. to 9 ft. being not uncommon. The tree is an extremely valuable one, whether for its timber its gum, or for the more important product, cutch, which is far and away the most valuable of all. It is an astringent resinous substance obtained by boiling down chips of the heartwood until the decoction has become a thickened extract, which solidifies on drying and cooling. It is interesting, in connection with its use for tanning or "cutching" fishing nets by the Kentish fishermen, to know that the preparation of this extract dates from a very remote period. It is mentioned by Sanskrit writers, and in 1514, in a description of the East Indies, a drug is described, under the name of "cacho," which was exported from Cambay to Malacca, and was in all probability cutch. In 1574 an account of the plant and the process of preparing the extract was given by Garcia de Orta. In the seventeenth century the substance, under the name of catechu, began to attract attention in Europe. It came by way of Japan, being re-exported from that island, and was at first supposed to be a natural earth, to which the name of *Terra japonica* was given, a name which has since become attached to true catechu, pale catechu, or gambier, which is an extract prepared in a similar way from the leaves and young shoots of *Uncaria gambier*, a rubiaceous plant of the Malay Archipelago, and cultivated in Singapore and Sumatra. This is a drug which is used medicinally as an astringent, while black catechu, or true cutch, from *Acacia catechu*, is used chiefly for dyeing and tanning, and is identical with the substance used by the Kentish fishermen in preserving their nets from decay, and of which very large quantities are imported into Great Britain yearly.

ORIGIN OF THE GUITAR AND FIDDLE.*

It has been long recognised that various stringed instruments have been developed out of the shooting-bow—*e.g.*, the harp of the North and the Greek lyre of the conventional shape—but no full explanation of the shape of the body of the guitar and the fiddle seems yet to have been given.

The peoples north of the Alps had originally no instrument with a sounding-board, for the addition of the latter to the harp came late. Thus the harp of the north and the *kithara*, which Apollo is fabled to have brought with him from the land of the Hyperboreans, are both simple adaptations of the primitive bow. On the other hand, Greek legend says that Hermes, the indigenous god of Arcadia, mollified the anger of the Northern Apollo by presenting him with a *chelys*, which Hermes himself had manufactured out of the shell of a tortoise, from which the instrument took its name (*chelys*). That such an instrument existed in Greece is no myth, for Pausanias (*circ.* A.D. 180) says that in Arcadia there are tortoises of large size, as well adapted as the Indian tortoises for making lyres. In the tortoise shell of southern lands Nature had furnished men with a natural sounding-board, whereas in northern lands none was ready to hand. The instruments with sounding-boards are, therefore, the product of the south. Guitars made of tortoise-shell are still commonly used in certain parts of the Mediterranean basin, *e.g.*, the specimens shown, one from Algeria, the other from North-west Morocco. In addition to the tortoise-shell, Nature has supplied other natural sounding-boards in Africa, *e.g.*, the gourd. Hence most African instruments have sounding-boards, not only the banjo and mandolin, but also more elaborate forms, such as the Marimba of Loanda. Now, whilst the banjo, mandolin, and bomba clearly arose from the addition of a gourd as sounding-board to the primitive shooting-bow, in the waist of the guitar and fiddle of South Europe we have a distinct development from the slight narrowing or waist to be seen in the shell of the tortoise. Accordingly, then, the characteristic instruments of South European lands owe their distinctive form to the fact that man in that region had at hand the tortoise-shell with its peculiar conformation.

* Abstract of paper read by Professor Ridgeway, before Section H of the meeting of the British Association, a York.

HOME INDUSTRIES.

The Harvest.—Agriculture remains the greatest of the home industries, and this year the harvest bids fair to be a little above the average. The hop crop is the exception, as was shown in these notes last week. Fruit varies a good deal, the frost and the north-east winds of April, and the drought later on, having in some districts seriously affected yield, but, on the whole, and notwithstanding the aphis, which has been particularly troublesome this year, the output is expected to be at least up to the average. In many parts of the country the corn harvest is now pretty well gathered, and wheat promises to be over the average, although probably not quite up to the exceptional yield of last year, when it was 32.78 bushels to the acre, or nearly $2\frac{1}{4}$ bushels above the mean of the previous ten years, and six bushels above the poor return of 1904. The preliminary agricultural returns are not out yet, and until they are the area of the crop will not be precisely known, but it is believed to be somewhat smaller than last year, when it increased from 1,375,284 acres to 1,796,995 acres, a recovery of 421,711 acres, or 30·7 per cent. upon the figures of 1904. This increase was attributed largely to the favourable seeding time during the autumn of 1904, and the weather was much less favourable last year. The straw of the present crop is short. Barley, on the whole, promises well, but will probably be somewhat below the average. The acreage under barley last year—1,713,664 acres—was the lowest on record, the reduction as compared with 1904 being 127,020 acres, or 6·9 per cent., and it would not be surprising to find that it has continued. Oats have suffered from the dry weather, but are not expected to be far short of the average in yield. For several years the cultivation of oats had been steadily increasing until last year, when, largely owing to the increase of the area under wheat, it fell 201,586 acres, or 6·2 per cent. It may be expected to show some little recovery this year. Spring beans have suffered from the aphis, which winter beans escape. The reports of the crop are favourable, and more so of peas, which, in districts where there has been enough moisture, have given a bountiful yield of pod and haulm. The reports are most favourable from the east of England. Last year there was a slight increase in the acreage of beans and a decrease in that of peas, but the changes were not considerable. The hay crop, on the whole, is below the average, but in the north there were some excellent yields, and altogether results are much better than were at one time expected. Last year it was the north that suffered most from the dry weather, and Cumberland had $10\frac{3}{4}$ cwts. below the average, while Northumberland and Westmoreland had deficiencies of 8 cwts. and over 5 cwts. respectively. The planting season was bad for potatoes, and the drought of last month checked growth, so that the yield is hardly likely to be equal to that of last year, when in England it was 7 cwts. above the ten-year mean. The root crop promises well where there has been rain, but generally has suffered from the want of it. Where harvest is late the condition of the corn crops may be affected by unfavourable weather, but a large portion of the crops has been got in in capital condition. It is only the hop grower who is likely to have very much to complain of in the matter of crop yields in 1906. Blight has played sad havoc in many of the hop fields, and the average yield is expected to be less than half that of last year, which at 14 cwts. per acre was the highest on record, and 64 per cent. over a ten years average.

Gas and the Incandescent Mantle.—One of the most noticeable points in connection with the gas industry is the rapid increase in the use of the Welsbach mantle, which is having an effect upon the sales of gas hardly contemplated by gas companies when the great improvement in the mantle recently brought it into favour with the public. For example, in the report of the South Metropolitan Gas Company for the six months ended December last, it is stated that there was an increase in consumption of only 1·5 per cent., and the main cause of the smallness of the increase was attributed to the great saving to the consumer by the constantly increasing use of the Welsbach mantle. For the half-year ended June 30, similar comparative shrinkage is shown. About 80 per cent. of the South Metropolitan Gas Company's consumers are using mantles, and it has been found that the consumption of gas is reduced, on an average, by about 21 per cent. The dividends of the gas companies will suffer but they remain generous, and the saving in gas bills is appreciable. Moreover the light given by the mantle is a great improvement. It may be noted that the convention controlling the price of thorium has this year reduced the price by about one half, with the result that for the time mantles will be plentiful and cheap. It is monazite sand from which the constituents of incandescent mantles (thorium 99 per cent. and cerium 1 per cent.) are obtained, and this sand has been mostly in the hands of a group of continental firms known as the Thorium Convention. The South Metropolitan Gas Company, has, however, succeeded in purchasing a monazite property in North Carolina which assures its supply of mantles at a reasonable price.

The Shipping Trade.—Attention was recently directed in these notes to the enormous quantity of new shipping coming into the market, and the distressing outlook for shipowners. It does not improve, nor can it. New ships are being put into the water out of all proportion to the requirements of trade. Something like a million and a-half tons of new merchant ships are in course of preparation in the United Kingdom alone, and the output abroad is exceptionally large. At the end of June, the Scotch shipyards, for instance, showed a total of 360,500 tons, which is about 100,000 tons more than in any six months on record. Nor is it only that the

new contracts given out at the end of 1904, and the beginning of 1905, are now nearing completion, and will compete for a portion of a carrying trade for which there are already too many carriers, and that the liners, with their huge dimensions, take more and more of the freights that used to go to the tramps. The regulations of the new free board, by altering the load line, have added largely to the carrying deadweight capacity of ships. This increase runs from about 2 per cent. in an ordinary cargo boat, to 5 per cent., or even more, in a large shelter-deck boat. Discussing this change, an expert writing in *The Times* says, that an exact average is impossible to define, "but it would not be extravagant to assume that this new free board adds fully 2½ per cent. to the competitive steam tonnage under the British flag." According to the latest issue of "Lloyd's Register Book," the total merchant tonnage of the world is 37,554,117 tons, of which 17,611,096 tons are on the British and British Colonial Registers. The steam tonnage on the British Register is 15,207,410 tons, and that tonnage must now be accounted as of about 2½ per cent. greater carrying capacity than last year. In other words, our effective tonnage in 1906 is being increased, not only by the abnormal amount of new tonnage launched, but also by the larger amount of cargo all British vessels can lawfully carry. Of course, it is to the advantage of the shipowner to be able to put 2½ to 5 per cent. more cargo in his vessels than he was allowed to do under the old rules, but that is only on the assumption that there is merchandise to carry, and there cannot be an adequate supply of merchandise for all the available tonnage, or anything like it. The expectation of a general "boom" in the international carrying trade, which induced the large shipbuilding orders referred to above, cannot be said to have been fully realised, but the carrying trade has been active, and under normal conditions the shipowners would be doing well. As it is, much disaster must be expected among the smaller co-partneries whose ships are bought on long credit, and have to rely largely upon luck for freight. No probable improvement in trade is likely to help them much. The position will right itself in time, but that will hardly happen during the next twelve months, and meantime freights will have to be accepted that, save in exceptional cases, will leave no margin of profit.

The Wool Trade.—All connected with the woollen industry have been prospering of late. The raw material has been plentiful, and the demand for the manufactured article brisk. Sheep stocks are rapidly recovering in Australia, and the current wool year is expected to turn out a record clip of wool. English farmers have been selling at prices generally showing 1d. to 2d. per lb. advance on what was made a year ago; and mills have been fully employed, with good prospects of growing activity, the fear being not of want of orders but of rise in the price of the raw material. The West of England trade has been very active, and in many places may be seen indications of confidence in the continuance of the prevailing prosperity. At Wellington the new Austrian carding machines have been introduced, which are very costly, but are said soon to repay the outlay by increased output. At Trowbridge a new weaving mill is being built to replace one recently destroyed by fire, and other extensions are being effected. At Stroud a leading company are installing an elaborate electrical plant to improve their driving and lighting, and elsewhere the experiment is being tried of introducing gas engines instead of steam. At Frome a new spinning and carding mill has been put up, and in other places in the West of England there are welcome signs of revival. Whilst the home trade is good, trade with the Continent has been excellent, and the colonial trade is satisfactory. Canada has taken large shipments of goods, the orders from Australia have been above the average, and even the South African market has shown some signs of improvement. The sales of wool in the Australasian markets for the year ended June 30 last reached a total of 1,354,865 bales, sold for £18,304,012, as compared with 1,092,651 bales, yielding £13,825,269 in the previous season, an increase in the value of the local sales of wool of £4,478,473. The total exportable production from Australasia amounted to 1,869,455 bales, valued at over £25,000,000, and this does not include 30,000 bales manufactured into cloths worth over £400,000. Immense as was the increase in the quantity and value of wool exports in 1905-6, it promises to be exceeded this year, so that the price of the raw material is likely to be kept within bounds notwithstanding the great and growing demand for the manufactured article.

The Cotton Industry.—Cotton piece goods exports continue to grow. Turkey, India, Australia, Japan, the Argentina Republic all keep up their demand, and the Colonies are sending increasing orders. The yardage exported in July was 573,527,800 yards as against 510,440,000 in the same month of 1905, and 474,622,400 in 1904, or taking the seven months to July 31 the exports were 3,690,231,400 yards as against 3,515,911,300 in 1905, and 3,068,106,700 in 1904. So with yarn. The exports for July reached 17,305,800 lbs. as against 16,291,700 lbs. in 1905, and 12,200,700 lbs. in 1904, and for the seven months the exports were 122,452,200 lbs. this year against 114,158,800 lbs. last, and 88,769,200 lbs. in 1904. Exports to China, owing chiefly to large stocks held in Shanghai, lag, but in all other directions the position continues excellent. Home trade cloths are in better demand than a year ago, and the margin of profit, which has been wide, is further improved by the recent drop in cotton. Nor is the outlook for the raw material in the coming year less favourable. There has been some bad weather in the United States, but the reports from the cotton-growing centres are generally very favourable and point to a larger crop next year than this; the East-Indian crop is believed to be

exceptionally good; the Egyptian crop is doing well; South America is likely to have more to spare, and the increase in the imports from the Colonies may be expected to continue. Output will now be lessened by the annual weaving holidays, and the spinning stoppages, which mean a much smaller production of coptwist and weft, but after the holidays it looks as if there will be a continuance of great activity for many months to come.

The Leather Trade.—The immense expansion of the motor industry has necessarily had a great effect upon the leather trade. Increased cost of tanning and finishing has been covered by rise in selling values, and the leading curriers have been more fully employed than for many years past. Many of them have doubled their staffs and could find work for more men if they could get them. Split hides of first quality have during the past year advanced from 2s. to 3s. each, and compared with the figures in January, 1905, the gain has been from 4s. to 5s. Rubber is still largely used for tires but its cost is so heavy that a covering has to be employed, and that is where leather comes in, the covering being made from prime, stout sole leather, both vegetable and chrome tannages being employed in its preparation. The leather tire produced from pig or hog skin is said to be very successful, being non-skidding, and very hard and durable. By-and-bye, the inventor will, no doubt, discover some material better than rubber or leather for tyres, but that time is not yet, and meanwhile the leather trade prospers greatly upon the development of the motor demand.

Industrial Occupations.—A contributor to *The Times* gives some remarkable figures bearing upon industrial occupations. During the last twenty years, the persons engaged in productive work have increased by 19 per cent., while the occupied persons, merely rendering services to others, have increased at the rate of 41·2 per cent. The population engaged in agriculture has diminished 11·4 per cent., and that engaged in textiles has been stationary. It has only increased 0·7 per cent., and has fallen from the third to the seventh place among the occupational groups. Mining shows an increase of 52·3 per cent., due to the increased export of coal. Metals, machines, &c., show an increase of 49·8 per cent.; building, an increase of 47·5 per cent., much of it due to municipal activity in effecting improvements; the brick, pottery, and glass industry shows an increase of 36·9 per cent.; and paper, &c., no less than 76·3 per cent. On the other hand, in the unproductive occupations every group, except domestic service, shows a large and in many cases an enormous increase. Thus Government (general and local), 90·2 per cent., defence, 57·1 per cent.; professions, 45·3 per cent.; commercial, 86·3 per cent.; conveyance 59·7 per cent.; gas, water and sanitary service, 170·8 per cent.; drapers and some other dealers, 73·0 per cent.; clerks have increased 100 per cent.; railway men 98·6 per cent.; carmen and carriers, 117·7 per cent.; dockers, 134·8 per cent. Trade and export have replaced productive industry, particularly transport, which has risen from the sixth to the second place among occupational groups. The writer whose figures we are quoting concludes that "the root cause of this change in the occupations of the people, with its consequences, is the system of free imports, which fosters trade and transport, combined with restricted foreign markets, which discourage productive industry." However that may be, his figures, which are not open to controversy, invite serious consideration.

OBITUARY.

JAMES DREDGE, C.M.G., M.Inst.C.E. — Mr. Dredge, one of the editors of *Engineering* since 1870, died on the 15th inst., at Pinner, after a long illness. He was born at Bath, his father (also James Dredge) being well-known as the designer of suspension bridges. On coming to London in 1858 he entered the office of the late Mr. D. K. Clarke, and in 1862 he joined the staff of the late Sir John Fowler, and was engaged in work connected with the construction of the Metropolitan District Railway.

Mr. Dredge was elected a member of the Society of Arts in 1889, and served as a member of the Council from 1890 to 1893. He read three papers on the Chicago Exhibition of 1893 before the Society in the years 1890, 1891 and 1892 respectively.

He was Commissioner-General for Great Britain at the Brussels Exhibition of 1897, and in 1898 was created a C.M.G. He wrote several works on engineering subjects.

NOTES ON BOOKS.

SELECT METHODS IN CHEMICAL ANALYSIS (CHIEFLY INORGANIC). By Sir William Crookes. 4th edition. Longmans, Green and Co. 1905.

This work, which may be considered as supplementary to a systematic work like "Fresenius," is too well known to need much introduction. Covering, as it does, the whole range of chemical analysis, the methods described are those which, for the most part, either by reason of their novelty or, more often, of their unconventionality, have not found their way into the smaller text-books, written for students, nor yet into so conservative a work as "Fresenius." Although new matter is added in this fourth edition, judicious excision and concentration have served to keep the volume to little more than its former dimensions. In some cases this appears to have led to slips which should be corrected when opportunity occurs: *e.g.*, on p. 211, a description of the determination of iron by reduction of the hydrochloric solution of the ore by stannous chloride, is given under the heading "Volumetric Estimation of Iron with Potassium Permanganate." A glance at the previous edition shows how this occurred.

Considered as a whole the work is a wonderful compilation; the many small points of manipulation, and accurate "short cuts" described, besides the more important descriptions of analytical processes give the work a value which is peculiarly its own. One feature on which the author from the beginning laid great stress, is the recognition of all the known elements, whereas it is usual to neglect those known as "rare." The platinum group receives considerable attention, as does also the cerium group, quite recent work being made use of. Electrolytic methods are given for the determination of several metals. It is only stating a mere fact to describe the book as one which no analytical laboratory should be without; it has taken a place in the literature of practical chemistry from which it will not easily be removed, although few, probably, would give unqualified approval to all the methods which receive the confirmation of the author. In most cases such matters are questions of taste and idiosyncracy rather than of acccuracy or inaccuracy.

Physical Chemistry and its Applications in Medical and Biological Science. By Alex. Findlay, M.A., Ph.D., D.Sc. Pp. 68. Longmans Green.

In this little work, which is described as being a course of seven lectures delivered (to medical students) in the University of Birmingham, Dr. Findlay gives a simple account of the more important developments of the knowledge of solutions and the application of these developments to the phenomena of "secretion" and other physiological processes.

The action of the kidneys in regulating the osmotic pressure of the blood; parthenogenesis as the result of the influence of certain ions, and the connection between toxicity and ionization in the case of the mercuric halides and cyanide, the ionic explanation of the presence of hydrochloric acid in gastric juice, and some physical aspects of serum therapy, are among the many examples of the bearing of physical chemistry on the economy of the animal body.

The book is clearly written, and should be useful to medical students and practitioners who wish to increase their knowledge of the fluids of the body.

Essays on Indian Economics: a Collection of Essays and Speeches by Mahadev Govind Ranade, C.I.E. Madras: G. A. Natesan and Co.

This is the second edition of a volume on several questions of interest in politics and political economy as illustrated in India and in Europe, by the late Hon. Mr. Ranade, Judge of the High Court of Judicature, Bombay. The first edition was published in 1898 during the author's lifetime.

Blackie's English School Texts. Edited by W. H. D. Rouse, Litt.D.

This is a series of books and portions of books by famous English classics for school use printed in good type, and sold for the small price of sixpence each.

Blackie's Modern Language Series.

This is a series of a rather larger size, and contains "Histoire d'Aladdin," illustrated by John Hassall; "Histoire de la Mère Michel et de son Chat"; and "Un Petit Voyage à Paris," par Marguerite Ninet.

A Skeleton French Grammar. By H. G. Atkins. London: Blackie and Son.

A convenient work for beginners intended to give the "irreducible minimum" for learners. The author says that "it does not profess to contain everything that the pupil....ought to know, but it does claim that he ought to know everything it contains." The points requiring particular attention are printed in red.

Guide to St. Olave's, Hart-street, in the City of London. Bryan Corcaran, 31, Mark-lane.

This illustrated guide to the interesting parish and church with which Samuel Pepys, the diarist, was so intimately associated, contains a useful key to the position of the many old monuments on the walls of the Church.

The Temple Greek and Latin Classics. Edited by J. L. Lowes Dickinson and H. O. Meredith. London: J. M. Dent and Co.

This is a well-printed series of classics, containing the original on one page and opposite the English translation. It contains the "Æneid" of Virgil; the "Medea and Hippolytus" of Euripides; and the "Euthyphro, Apology, and Crito" of Plato. Each volume is illustrated with a portrait from original statue, bust, or gem.

GENERAL NOTES.

The Wealth of France.—In his report on the French Budget for 1896 Mr. Reginald Lister, Councillor of H.M.'s Embassy at Paris refers (3676, Annual Series) to the wealth of France. The total income of France has been estimated by certain economists at £1,200,000,000, and the estimates of the national fortune in accumulated capital vary between £8,000,000,000 and £9,000,000,0000. To arrive at this calculation the system known as that of "l'annuité dévolutive" has been followed. The "annuité dévolutive" is obtained by taking for each year the successions on which duty is paid and adding to them the amount which changes hands by gift. Taking the average life of a generation to be 32 years the "annuité dévolutive" represents 1-32nd of the total fortune of the country. If 1904 is taken as an average "annuité dévolutive," namely, £266,000,000, and it is multiplied by 32, the sum of £8,500,000,000 is arrived at as representing the national fortune of France. A Bill is now before the French Legislature for the creation of an income-tax, a distinction being made between income derived from capital and income derived from labour, in favour of the latter.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

SECTIONAL COMMITTEES.

APPLIED ART SECTION COMMITTEE.

The following is the list of the Applied Art Section Committee, as appointed by the Council :—

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Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D. (Chairman of the Committee).
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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FIRE, FIRE RISKS AND FIRE PREVENTION.

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Lecture III.—Delivered March 26th, 1906.

In the storage of inflammable material in bulk dangers which hardly exist with small quantities of material often become of a serious character, and it is the increase in mass which in most cases leads to those actions that culminate in spontaneous ignition. As was pointed out in the first lecture many substances, especially of vegetable origin, undergo slow oxidation at temperatures below the ignition point, and it is only the fact that the action is spread over a long space of time which prevents us from realising that heat is being evolved. A certain increment of temperature, however, is generally needed to start the slow combustion, but once the required rise takes place and the action commences, then the surrounding mass of material keeps in the heat, and, as chemical action increases in rapidity with increase of temperature, in some cases the ignition point is reached.

The necessary initial rise of temperature may be brought about in several ways:—(1) By physical action, as in the absorption of a large volume of gas and its compression in the pores of a substance like charcoal; (2) By increase in the temperature of the air; (3) By a direct chemical action taking place at the ordinary temperature; (4) By the action of ferments on most organic matter. To the first-class belongs the spontaneous ignition of a mass of powdered charcoal or a mass of lamp-black.

We saw in the last lecture that when charcoal has been burnt at a fairly high tempera-

ture it was not nearly so dangerous as when charred at a low one, and that this was due to the fact that low-burnt charcoal contained certain compounds of hydrogen, carbon, and probably oxygen of a more or less pyrophoric character. The high-burnt charcoal, however, is nearly pure carbon, and in its production the cellular structure of the original wood is maintained, owing to the infusibility of the carbon that forms its walls. This structure enables a freshly-burnt piece of charcoal to absorb very considerable quantities of gas, and the absorptive power of dense charcoal is shown in the following Table:—

One vol. of charcoal at 0°C. and 760 mm. absorbs—

Ammonia	171·7	volumes.
Cyanogen	107·5	,,
Nitrogen dioxide	86·3	,,
Ethylene	74·7	,,
Nitrogen monoxide	70·5	,,
Phosphuretted hydrogen	69·1	,,
Carbon dioxide	67·7	,,
Carbon monoxide	21·2	,,
Oxygen	17·9	,,
Nitrogen	15·2	,,
Hydrogen	4·4	,,

The absorption is very rapid at first, but gradually decreases, and is, moreover, very much influenced by temperature. It is at first purely mechanical, and itself causes a rise of temperature, which in the case of charcoal formed in closed retorts, as in preparing alder, willow, and dogwood charcoal for making gunpowder, would produce spontaneous ignition if it were not placed in sealed cooling vessels for some days before exposure to air. The rate of absorption varies with the surface exposed. When charcoal is finely powdered the exposed surface being much greater, absorption becomes more rapid and rise of temperature at once takes place. If after it has been made charcoal is kept for a day out of contact with air and is then ground down into a powder, it will frequently fire after exposure to the air for thirty-six hours, whilst a heap of charcoal of 100 bushels or more will nearly always ignite. It is for this reason that in making the charcoal for powder it is always kept after burning for three or four days in air-tight cylinders before picking over, and ten days to a fortnight before it is ground.

Lamp black, which is largely used for the production of printer's ink and as a pigment, shows the same power as charcoal, and is if anything a little more dangerous, as it contains a small quantity of oily matter derived from the hydrocarbons burnt to yield it, and also sometimes small quantities of sulphur.

In the spontaneous ignition of coal stored in bulk in our gasworks, or being carried in large consignments in vessels to distant ports, we find both absorption of oxygen and increase in temperature playing an important part. There is probably no form of spontaneous ignition that has claimed a heavier tax both in men and money than that of coal, ships engaged in the carriage of this commodity to ports in the Far East having been specially liable to loss from this cause.

Coal, which is the fossil remains of a monster vegetation that grew long before the earth was inhabited by man, may be looked upon as containing much the same constituents as a lightly-burnt charcoal rendered dense by pressure during its formation, and richer in hydrocarbons, owing to the prevention of the escape of these bodies during its formation. It contains, moreover, not only the inorganic material present in the sap of the original plant, but also mineral matter formed in it by infiltration and reduction during the long ages of its production. It may, therefore, be looked upon as consisting of carbon, hydrocarbons and inorganic constituents. Amongst these latter we find iron pyrites or disulphide of iron, which occurs sometimes as bright golden laminæ in the cleavage of the coal, sometimes as heavy and metallic lumps where it has formed in a cavity of the coal, and occasionally in a finely-divided and feathery form spread through portions of the coal itself.

If these pyrites be collected from the coal and made into a large heap exposed to air and moisture, they rapidly heat and often inflame, owing to the oxidising action of the air and moisture upon the sulphur, and it is still believed by many observers that it is this action in the coal itself which gives rise to its spontaneous ignition.

The fact is, however, that many coals containing a high percentage of pyrites are perfectly safe, and have never been known to heat seriously or ignite, whilst other classes of coal, practically free from pyrites, invariably suffer from spontaneous ignition under conditions favourable for its production.

A careful study of the phenomena occurring during the heating of a mass of coal leads to the conviction that the pyrites present can only play a very subsidiary part, and that it is in reality the absorption of oxygen by the freshly-won coal and the activity of the condensed

gas in contact with the hydrocarbons of the coal that are the active factors in causing the ignition.

In the coal seam the pores of the coal (for a trace of the original structure still remains in it) are filled with methane, or a mixture of methane and carbon dioxide, gases produced during the actions that led to the formation of the coal. When this coal is won and brought to the surface, the coal exudes these gases from its surface, and in turn absorbs oxygen from the air. The action, however, cannct go on to any great depth in the coal, and while the pieces are fairly large no heat shows itself, but as the coal gets more and more broken by jolting during carriage and shooting into the ship's hold, the surface becomes enormously increased, and the mass of fine coal formed under the tip and below the hatchways in the ship is generally the spot at which heating and eventually ignition develops.

The mere absorption of the oxygen, however, is insufficient to bring about serious consequences unless there be an initial rise in temperature to start the action, and in coal-cargo ships it is found in the enhanced air temperature in the tropics, in ship's bunkers by contact with the casings near the boilers, and in coal stores on shore by proximity to a steam-pipe or flue. In every case it was found that the spontaneous ignition of the coal started at the point where the cause of the initial rise of temperature was to be found.

The old idea as to the treatment of coal to prevent spontaneous ignition was to provide ventilation, and this would be perfectly effective if the free flow of air through the mass of coal could be obtained, but this is impossible in a cargo on board ship, and difficult even in a coal store, the result generally being to supply just enough air to lead to dangerous heating. Well authenticated cases are not rare of ventilated ships being lost, whilst vessels laden with the same coal, the cargo having been simply battened down, have reached their destination safely.

Moisture is a very powerful agent in aiding chemical action and, as is well known, many forms of combination, such as the burning of carbon monoxide in oxygen, and even the combination of phosphorus with oxygen are prevented if both the reacting substances are perfectly dry. In the same way the action of the occluded oxygen in the coal is enormously aided by the presence of moisture, so that heavy rain whilst a coal cargo is being taken on board, or being stored, generally results in heating and often in active danger.

The latest suggestion for the prevention of spontaneous ignition in coal, however, is to wet the coal cargo or mass of coal in store, and as long as the coal is practically kept awash with water, this no doubt would be effectual, but in practice I can conceive no more dangerous suggestion, as a ship owner has no desire to limit the carrying capacity of his vessel by taking in a large quantity of water, and so would merely moisten the coal to a degree that would increase rather than lessen the danger, whilst if it were attempted to wet only the portion below the hatchways, where heating and ignition generally show themselves in a most marked way, a few days under hatches would suffice to cause the evaporation of the water from that spot, and its fairly equal distribution throughout the cargo would present the most favourable conditions for serious heating.

In coal stores on land the action of weathering is perfectly well recognised, and it is well known by the gas manager that in coal which has been stored for a long period loss in hydrocarbons takes place, which shows itself in either diminished volume or decreased luminosity in the gas produced from long-exposed coal.

In this case, as in all others, mass plays a very important part, as may be seen from statistics with regard to cases of ignition of coal cargoes shipped to Eastern ports. With 500 tons of coal to the cargo the cases of spontaneous combustion amount to only about a quarter per cent., whilst, when the bulk is increased to 2,000 tons, the number of cases of spontaneous combustion rises to 9 per cent.

In order to prevent the spontaneous ignition of large masses of coal, the most important precaution to take is to prevent as far as possible breakage during storing, as the exposure of fresh surfaces of coal just at the time when it is being put under conditions in which the heat generated by the action of the oxygen cannot escape, is one of the chief factors that generally leads to the danger. The breaking up of the coal which has taken place in the earlier stages of its career has probably had time to complete this action and get rid of the heat to the air, whilst in the store itself the greateat care must be exercised in order that no flue, drain, or steam-pipe that can give rise to an increase in temperature is anywhere near the stove.

Before leaving the question of the spontaneous ignition of coal it might be well to deal with the question of the treatment of coal fires on board ship, which is just one of those cases in which the means we generally adopt for extinguishing a fire are practically inadmissible. Given a mass of coal in the hold with a pocket of incandescent coal near the bottom, the difficulty is in the first place to get at it, and the first impulse is to pump water in and let it find its way to the seat of the combustion. The water, however, cannot get freely to it in quantity, having to filter its way down through the interstices of the coal, meeting as it does so the hot products of combustion, and being evaporated off in cooling these down. The portion that does reach the seat of the combustion, on coming in contact with the red hot mass of carbon, is largely converted into water-gas, a mixture of carbon monoxide and hydrogen, which only requires a small proportion of air to convert it into a highly explosive mixture. This, collecting under the decks, explodes, ripping up the deck and blowing off the hatches, thus letting in free access of air to carry on the combustion, which generally leads to the total loss of the ship.

In order to obviate this danger steam has been frequently used, but it is even more difficult to get steam to the required spot, and steam, like water, is decomposed into water-gas by incandescent carbon. The cooling action that steam has upon the burning mass is far less than would be the case with water, the chief value of which as an extinguishing agent is the large amount of heat rendered latent during its vaporisation.

There are certain gases, however, which have a great power of stopping combustion by keeping away the oxygen of the air from the burning substance, and some of these have been proposed for the extinction of such fires.

If we burn sulphur in oxygen the gas sulphur dioxide with its choking smell is generated, and this gas has a powerful effect in preventing and extinguishing fire, a small percentage of it being sufficient to extinguish flame. The action of it, however, is purely extinctive and in no way cooling, and with a cargo on fire the cooling down of the mass is every whit as important as the extinction of the active combustion.

Another gas which acts in precisely the same way is carbon dioxide, but here again, if carbon dioxide be merely generated and pumped into the area containing the burning matter, no absolute cooling is effected, and although the use of these gases was suggested over thirty years ago, it was this trouble which prevented their adoption.

Fourteen years ago I pointed out in this room that with a proper arrangement of apparatus carbon dioxide could be made not only a most valuable extinctive agent, but also one of the most powerful cooling materials one could obtain. When carbon dioxide is compressed under a pressure of 36 atmospheres at a temperature of 0° C. (32° F.), it is condensed to the liquid state, and can be stored in steel vessels with screw valves. On opening the valve some of the liquid is ejected into the air, and being reduced to the ordinary pressure, is almost instantaneously converted into a large volume of gas. Conversion from the liquid to the gaseous state means the absorption of a large amount of heat, and so great is this that everything near the stream of new-born gas is cooled down, and some of the escaping liquid is frozen to a solid, having a temperature of − 78° C. (− 108·4° F). The liquid carbon dioxide is now an everyday article of commerce, and is used to a large extent for aerating waters, driving torpedoes, and for freezing machines.

In applying this to coal cargoes I suggested that small cylinders of carbon dioxide should be taken, and the nozzle attached to the screw valve on the bottle of condensed gas should have a metal nosepiece screwed on to it, the tube of which should be cast in solid with an alloy of lead, tin, bismuth, and cadmium, which can be so made as to melt at 93° C. (200° F.). The valve should then be opened and the steel bottle buried in the coal during the process of loading. The temperature at which the fusible metal plug would melt would be well above the temperature that could be reached by any legitimate cause, and would mean that active heating was going on in the coal. Under these conditions the pressure in the steel cylinder would have reached something like 1,700 lbs., and the moment the plug melted the whole contents of the bottle would be blown out of it into the surrounding coal, producing a large zone of intense cold, and cooling the surrounding mass to a comparatively low temperature. The action, however, would not stop here, as the cold, heavy gas would remain for some time in contact with the coal, diffusion taking place but slowly through the small exit pipe.

When the coal has absorbed as much oxygen as it can, it still retains the power of absorbing

a considerable volume of carbon dioxide; and when coal has heated and then been rapidly quenched, the amount of gas so absorbed is very large indeed, and the inert gas so taken up remains in the pores of the coal and prevents any further tendency to heating. Indeed, a coal which has once heated, if only to a slight degree, and has then cooled down, is perfectly harmless, and will not heat a second time. It is not by any means necessary to replace the whole of the air in the interstices of the coal with the gas, as experiment shows that 60 per cent. of carbon dioxide prevents the ignition of the most pyrophoric substances.

One hundred cubic feet of gas can be condensed in the liquid state in a steel cylinder 1 foot long and 3 inches in diameter, and a ton of coal contains air spaces equal to about 12 cubic feet, so that one of these cylinders would have to be put in for every 8 tons of coal, and should be distributed evenly throughout the cargo, and near to alarm thermostats set to ring in the captain's room a degree or two below the point at which the fusible plug would melt. The ringing of the bell would give warning that heating was taking place, and the bell would continue to ring until the cylinder had discharged its contents, and had cooled the cargo down to a safe degree. The whole arrangement, therefore, would be purely automatic, and yet the officers would know if everything were safe.

Liquid carbon dioxide is now being made at a comparatively cheap rate, and, if the necessary demand arose, machinery could be put up at the principal coaling ports to charge empty cylinders at a very low rate, so that, the initial cost of the steel cylinders once got over, the expense would not be worth considering, more especially as only one or two at the most of the cylinders in use would be likely to be discharged.

If the precautions advocated were taken, no danger could arise until the arrival of the ship at her destination, and the commonest precautions would then suffice. On removing the hatches no naked light would be allowed near them, and no one would be allowed to descend into the hold until all the gases had had time to diffuse out into the air. If the cylinders had blown, there would be but little fear of explosion, as the high percentage of carbon dioxide would lower the explosive power which the mixture of methane (given off from some coals) and air possesses; but the carbon dioxide would overcome and suffocate a man descending into an atmosphere containing any considerable percentage of it. When a safety lamp lowered into the hold continued to burn as brightly as it did in the open air, then it would be perfectly safe to descend.

This proposition, however, was never taken up, partly because there was a fear that under the influence of heat the cylinders might explode, but if they had been made in the same way as those used for the compressed hydrogen employed in military balloons are made, there would have been no fear of a shattering explosion, the worst that would have happened would have been a ripping up of the cylinder along the weld of the seam, which would have done no harm, but would have been extremely efficacious in at once putting out the fire.

Several firms have, however, adopted the idea both for the protection of coal cargoes and stores containing such goods as cotton, jute, or wool in bales, in which it would be extremely difficult to get at the fire by any other means. In most of these cases the cylinders are arranged externally to the store, and the gas only turned on when a fire is discovered.

It must be remembered that with the use of sulphur dioxide instead of carbon dioxide the same cooling effect would never be attained, and that the gas is so irrespirable that 4 parts in 10,000 render air incapable of being breathed, whilst with carbon dioxide, although 3 to 4 per cent. will extinguish flame, a man can breathe for some time an atmosphere containing over 10 per cent. without danger.

The spontaneous ignition of oily waste or other fabric, which is one of the most prolific causes of mill fires if proper precautions be not taken, is an excellent example of chemical action at ordinary temperatures supplying the necessary initial heat to start a more rapid action.

It is well known that some oils have the property of drying more rapidly than others, and that if a powdered pigment be mixed with boiled linseed oil, the paint so formed will harden and dry in a few hours, whilst if ordinary lamp oil be employed no drying action would take place.

The drying of oils is due to the power which they possess of taking oxygen from the air and becoming converted into resins, the change from the liquid oil to the solid resin causing the hardening. This process, however, like all processes of oxidation, gives rise

to heat, which, although it escapes our notice when taking place in the drying of paint spread over a considerable surface exposed to air, yet makes itself very manifest when the oil in a fine state of division is spread over the surface of such non-conducting materials as cotton or other fabrics of a similar character, and it only needs a few pounds of such materials to be allowed to collect in a heap for ignition to follow in a comparatively short space of time. Hundreds of well-authenticated cases of fires caused in this way could be adduced, and the only means of prevention is to take every precaution against the collection of oily material, and to destroy it either by burning or thoroughly wetting in an enclosed metal bin.

Jute offers the same dangers as cotton when in bulk and oiled, spontaneous ignition sometimes occurring even more easily than with cotton, whilst the same danger is found when the jute is in a thoroughly dry condition and exposed to moderate warmth from a steam-pipe or flue, or even the rays of the sun.

In store wool and jute are both liable to spontaneous ignition when wetted with water and compressed, whilst the natural fat or grease in wool is a source of danger only when the wool is compressed or very dry.

The best known example of the temperature of ignition being reached by actions started with a rise of temperature due to bacteria causing fermentation is to be found in the spontaneous ignition of stacks of badly made hay.

If in making hay the cut grass be thoroughly air-dried by exposure to the heat of the sun and air, the germs which are in it are mostly sterilised, and the moisture is reduced to a point at which they are unable to set up fermentation processes. If the hay after being once properly made gets wet the stack may go mouldy, but the more dangerous process of fermentation is so checked that a temperature likely to reach the ignition point of the stored hay is never attained. If on the other hand the hay has been made into a large stack whilst still containing any of the original moisture, the germs of fermentation will still be present in large numbers, and when the stack is made fermentation will start, and this being an oxidising process will give rise to heat. This heat is kept in by the surrounding mass of hay, which is an excellent non-conductor, and soon reaches a dangerously high temperature, and in many cases where actual ignition has not taken place, on cutting trusses out from the stack it has been found that some of the hay is practically carbonised, and had air gained access to it whilst still at the temperature that caused the charring, ignition of the whole stack would have followed.

The use of petrol or petroleum spirit in large quantities for oil motors and the necessity for storing it in bulk has of late given rise to a danger which before only existed to a limited extent.

Petrol is the first distillate from the crude oil as it comes from the oil well, and largely consists of pentane, $C_5 H_{12}$, and hexane, $C_6 H_{14}$, the first liquid members of the great paraffin group of hydrocarbons. This liquid is volatile even below the freezing point, and a pint of it poured on a level surface will cover about 80 square feet with an inflammable vapour, through which on coming in contact with a light a flame will spread. One pint of the liquid will also give enough vapour to render 100 cubic feet of air highly explosive.

These light oils have a wonderful penetrative power, and it is a matter of considerable difficulty to get vessels made for commercial purposes sufficiently vapour tight to resist the insidious creeping of petroleum spirit. The result is that in stores, cellars, and other places where vessels containing such spirit are kept, slight leakage and evaporation into the air are constantly occurring, and as the evaporation of one volume of liquid petroleum spirit would render 5,000 volumes of air strongly explosive, it is clear that special precautions must be taken in dealing with the storage and use of such spirit.

The temperature needed for the ignition of explosive mixtures of petroleum vapour and air is comparatively high, and experiments made by Colonel Majendie, Sir Boverton Redwood, and Dr. Dupré show that such mixtures were not ignited by the glowing spark on a splint of wood, a red hot coal which had ceased to flame, or a shower of sparks from a flint and steel, and that it needed a temperature of platinum wire raised nearly to a white heat before explosion took place, that is about 1,400° C.

One of the greatest dangers with the vapour of volatile hydrocarbons is that the great weight of the vapour as compared with air will cause it to creep along surfaces for very long distances, and then on reaching a light the flame flashes back along the vapour to the source from which it sprang.

It may be accepted that the transport and storage of refined lamp oils and residuum are

practically free from danger, the only point to be guarded against being the ignition of the liquids in volume during fires, while the real dangers to be guarded against are to be found in the transport and storage of crude oils containing highly volatile constituents, and with petroleum spirit.

In all confined spaces used for the storage of such material, the adoption of the safety lamp, and the constant testing of the atmosphere by the beautiful method devised by Dr. Clowes and Sir Boverton Redwood would go far towards ensuring safety.

In the early days of the last century, when the introduction of coal-gas gave rise to an increased demand for coal, explosions in mines became of such frequency that attempts were made to safeguard the miners' lives. As the result of the labours of a Royal Commission appointed to enquire into the subject, and the experimental researches of Sir Humphry Davy and George Stephenson, the safety lamp was installed in all fiery pits. Long before this period, however, the miners themselves had utilised a rough test for detecting the presence of the dread fire-damp in anything approaching dangerous quantities. It was well known that even a small percentage of methane in the air of the pit gave rise to the appearance of a small flame cap above the flame of the burning candle, and as the miner went down into the workings with this candle fixed at the end of his primitive candlestick—a wooden lath—in front of him, he would shade his eyes from the glare of the flame, and watching its tip would blow out the flame for very life the moment that the ghostly cap appeared. This flame cap not only gave an indication of the presence of fire-damp, but according to its length also indicated roughly the proportion that was present, and it is upon a modification of this principle that our most modern and successful methods of detecting explosive gaseous mixtures and roughly estimating the proportion of explosive gas present have been based.

With the introduction of the safety lamp it was still found that the flame served to indicate the proportion of combustible gas even when still below the explosive limit, the change in the appearance of the flame giving a very fair guide to an experienced man of the proportion of fire-damp present, whilst when the dangerous limit in the atmosphere had been reached the fire-damp would burn within the lamp, and by its products of combustion rapidly extinguish the flame.

In those early methods of judging the nature of an atmosphere that might be explosive by means of a flame cap, it is clear that the flame employed being luminous and the cap of a very faint shadowy nature, the glare of the luminous portion of the oil or candle flame might seriously interfere with ease of observation. As it was gradually realised that this phenomenon gave the simplest and most convenient method of testing, the apparatus was improved from time to time with a view of making it more accurate, and by the replacement of the gauze in the lower portion of the safety lamp by glass, and by shielding the direct light of the lamp from the eye, considerable advances were made, but it was only when the luminous flame was replaced by a non-luminous hydrogen flame, and mechanical devices were adopted for setting the test flame to an accurate height and maintaining it at this point that the method attained any degree of accuracy. The miner's test lamp, as devised by Professor Clowes, has been adopted almost universally in mines.

When it became clearly evident that the development of the carriage of crude petroleum in bulk, and the carriage and storage of petroleum spirit necessitated analysing the atmosphere in tanks and stores, this method of testing naturally suggested itself, and Sir Boverton Redwood succeeded in devising a special modification of the lamp, and also an apparatus for collecting samples of the atmosphere in which petroleum vapour was suspected, and testing them under uniform conditions.

The apparatus consists of the lamp, the cylinder of compressed hydrogen, and a sampling vessel. The base of the lamp is fitted with two inlet tubes, one for the sample of atmosphere, and the other for the hydrogen, the latter being provided with regulating tap and jet. Immediately above the tube for the inlet of the vapour-laden sample is a series of baffles, on the top of which are three discs of very fine wire gauze, which regulate the flow of gas and prevent any flashing back of the flame into the sampling vessel. The hydrogen jet is partially enclosed by a metal tube, the front of which is removed, and over this slides a chimney partly of metal and partly of glass, the metallic portion being blackened inside. In the window are lines corresponding to various heights of flame caps.

The collecting vessel consists of a compression pump fitted with a metallic piston fixed inside a strong metal cylinder, which is

furnished with a pressure gauge and valve, and also has connections and taps for collecting and delivering the sample. About thirty strokes of the pump suffice to charge the cylinder to a pressure of 30lbs. to the square inch, when it will contain one-third of a cubic foot of the atmosphere sampled.

In using the apparatus the hydrogen cylinder is connected to the lamp, and the sliding chimney being raised, the hydrogen is turned on and lighted. The supply is adjusted to give a flame of slightly more than 10 millimetres in length, and the apparatus is left for a few minutes to warm up so as to drive off any condensed moisture from the surface of the chimney. The collecting vessel is attached to the other inlet of the lamp, the chimney is closed completely, and the hydrogen flame finely adjusted by the regulating valve till the tip of the flame is just hidden when the eye of the operator is on a level with the bottom of the window. The lamp and head of the operator are then covered with a light-tight cloth, and the tap of the collecting cylinder turned on. Even with a proportion of vapour that is too small to give an explosive atmosphere a cap of a greyish-blue appears on the flame. As the proportion of vapour increases, the flame cap becomes better defined, followed by considerable enlargement of the cap, this feature occurring before the atmosphere contains sufficient vapour to render it inflammable.

When petroleum spirit has once taken fire it is most difficult to deal with, as, being far lighter than water, even when great volumes are poured upon the fire the spirit rises to the surface and continues burning, whilst the vapour given off prevents any cooling of the liquid from proving efficacious. Chemical extincteurs and gases like carbon dioxide and sulphur dioxide can only act upon it if the fire be in a very confined space, as the updraught caused by the fierce flame sweeps them away and sucks in air to the burning mass. Sand or fine mould is the best thing for extinguishing a petrol fire, and if this is not at hand in sufficient quantity, the next best thing is to let the fire burn itself out, and devote one's whole attention to protecting surrounding property.

The formation of any large quantity of organic dust floating in the air is a very distinct danger, as not only is dust liable to become pyrophoric in its nature when lightly charred on hot-water pipes or heating apparatus, but when suspended in quantity in air gives an explosive atmosphere through which a flame will flash from an exposed light for great distances. Fires frequently occur in flour mills and other places where finely divided combustible material is liable to become mixed with the air

All finely divided particles have the power of occluding or taking up oxygen from the air, and with many forms of combustible dust this has been found to take place to such an extent that a flame will flash through it even when the dust is suspended in an atmosphere that would not support ordinary combustion. It can also be proved that if a trace of an inflammable gas be present in air, although the quantity may be so small as to be far below the explosive point, a small quantity of dust suspended in the air will make it at once violently explosive. This is a very great danger in coal mines where a small trace of fire-damp may be made actively dangerous by a quantity of dust raised during blasting operations, whilst an escape of gas in a flour mill which might be so small as not to be detected by the nose, would make an atmosphere containing flour dust actively explosive.

Another very dangerous form of material for storage is collodion, which during the past few years has been extensively used for the manufacture of imitation amber, tortoiseshell, ivory, and even artificial silk.

When in 1845 Schonbein discovered guncotton and made it by nitrating cotton with the strongest possible nitric acid, it was also discovered that if the strength of the acid became reduced a lower form of nitrated cotton was produced, which was soluble in alcohol and ether. On allowing the solvent to evaporate off it left the nitrated cotton in the form of a thin semi-transparent film, which was at once pressed into the service of photography under the name of collodion, whilst soon after this same material was utilised for making other substances, the industry now having grown to an enormous extent.

The danger of such collodion goods is the low point at which they ignite and burn with great fierceness, the ignition point sometimes being as low as 150° C. (302° F.), and rarely exceeding 200° C. (392° F.). When the collodion is used for making a fabric for dresses, such as artificial silk, the danger became so grave that for this purpose at any rate after manufacture, the collodion had to be denitrated by treatment with some body like ammonium sulphide, which reconverted the explosive nitrocellulose back into the harmless cellulose.

The collodion cotton prepared for making

the solutions and emulsions employed in these manufactures owes its great danger to the fact of the cotton fibres consisting of minute tubes, which retain with great pertinacity traces of the acids used in the nitration, and unless this acid be entirely eliminated, the nitro-cotton during storage undergoes decompositions, which soon emit sufficient heat to reach its low ignition point.

In the mixed storage of various substances many unexpected dangers arise, especially if there be present amongst the materials oxidising agents, that is, bodies rich in loosely-held oxygen, and a very considerable amount of chemical knowledge is necessary to gauge whether or no danger arises from the simplest bodies, as should fracture of a bottle or package arise and bring about a mixture, unexpected phenomena are developed. For example, it is not unusual to find in a dry goods store packages containing crystals of potassium permanganate, which, dissolved in water, give a very valuable disinfecting liquid —Condy's fluid; whilst glycerine, so frequently used for chapped hands and as an emollient for the skin, would not be a substance which to an ordinary man would suggest any degree of danger, but should a bottle of glycerine upon the shelf of a store be cracked, or some of the glycerine be spilt during transfer to another vessel, and drip on a cask or package containing potassium permanganate, excessively fierce combustion would be at once created, whilst even water itself coming in contact with such substances as potassium or sodium gives rise to violent combustion.

FOREIGN TRADE OF THE EAST.

The foreign commerce of the East aggregates between 600 and 800 millions sterling annually, and the population is nearly 900 milllions, or more than half the people of the world. Oriental commerce has been a subject of interest ever since relations were established between the East and the West. The sharp contrasts between the customs of the people of the East and those of the West, the ingenuity and patience of the Eastern races, and their plentiful and inexpensive labour supply, have enabled them to offer many articles greatly prized by the Western races. The further fact that a large proportion of the Eastern people occupies areas climatically different from those occupied by the more advanced section of the Western people adds greatly to the stock which the Oriental producer and merchant may successfully offer. Tea, silk, fibres, spices, gums, dye woods, ivory, and originally sugar, coffee, and other articles highly prized in every part of the world, were the products of the East. They are still in most cases largely produced, and to them are added, through the patient labour of an enormous population, numerous manufactures the product of hand labour, and carvings of gold, silver, and ivory. Meantime, the Western races have sought to induce the Eastern races to accept their products in exchange for those which the former have bought so freely, and they have found it a difficult task.

The sharp contrasts between customs as to food, clothing, and habits of agricultural life and the household, coupled with the poverty of the masses in the East, and their relatively small purchasing power, offer difficulties in finding opportunity to exchange Western products for those of the East. Every commercial nation of the West has made efforts to invade the markets of the East, while no Eastern nation has until very recent years made the slightest effort to extend its trade with the West. In a monograph, recently issued by the United States Bureau of Statistics, it is stated that every steamship which carried merchandise between the West and the East was, until a very recent period, built and despatched by the people of the West; every facility for inter-communication and for the shortening of trade routes, and every railway or road by which the interior of the Eastern countries was reached, was until recently the product of Western enterprise. In finding Eastern markets in which products might be exchanged, the Western man, whether European or American, has encountered peculiar difficulties in the fact that Oriental habits of life are entirely different from those in his own part of the world. The food and clothing and the requirements of daily life are distinct from those of the people for whom he has been accustomed to cater. This is especially true of that great area lying within the tropics, which forms the home of half the Eastern people, and which supplies two-thirds of the Eastern products which the West requires.

Oriental man, who originally occupied the district east of the Mediterranean, was carried by the westward movement of Mohammedanism across northern Africa and into south-eastern Europe. Retaining his customs of life he extended the East to the Atlantic in Africa and into that section of Europe now known as Turkey. Africa, from Morocco at the north-west to the southern end of the Red Sea, is Oriental, as also is Turkey in Europe, while thence eastward Eastern supremacy extends over southern and central Asia to the Pacific and throughout the islands of the East Indies. This great section, sweeping south-east from Morocco to Java, and again north-east from Morocco, past Turkey and China, to Japan, is a distinct commercial area, with its lines as sharply defined by economic conditions as those by which continents and other great geographical sections are marked through other natural causes. The section occupied by people of Oriental customs, stretching from Northern Africa to the Pacific, contains more

than half the world's population, although it has but about one fifth of the land area of the globe. It includes Morocco, Algiers, Tunis, Tripoli, and Egypt, in Africa; Turkey in Europe and Asia; Persia, India, Ceylon, Burma, the Malay Peninsula, Java and other East Indian Islands; Siam, French Indo-China, the Philippines, China, Korea, and Japan, and its total population is in round numbers nearly 900 millions, while the remainder of the world has less than 800 millions. Its total international trade is between 600 and 800 millions sterling, of which about half is composed of imports, and one-half exports. Practically two-thirds of this trade are carried on with Western nations, the remainder being exchanges among the various countries of the East.

The manufacturer or merchant who desires to obtain a footing in Eastern markets can only do so successfully by offering the kind of merchandise to which these markets are accustomed. For generations the manfacturer has been offering wares in the form to which his own people were accustomed. In a few articles absolutely requisite, and found only in one general form, such as mineral oil for lighting, the Oriental has accepted, and adapted himself to the commodity offered, but the very large proportion of articles offerəd he declines, unless they are so prepared as to meet the habits of life to which he and his father before him has been accustomed. Even in cotton goods, a universal requirement for clothing in the East, he insists upon weights, lengths, colour, and patterns similar to those to which he has been accustomed for generations, and no amount of persuasion can induce him to accept other patterns or styles which the Western manufacturer may consider equally good or even better. This characteristic prevails with reference to practically all classes of goods successfully sold in the East. It is the knowledge of these characteristics, born of long experience and study of the markets, which has given to the manufacturers and merchants of Europe their almost absolute control of the markets of the East, and especially of the Far East. In the tropical East, by which is meant all Orientals south of Central China, the imports aggregate 200 millions annually, and of this the experienced Europeans are able to supply 66 per cent., and steadily increase the total, while the United States supplies but 1 per cent., and makes practically no increase. In that section of the East, however, lying in the temperate zone, the United States is making good progress in certain lines. In cotton goods, mineral oils, and copper for China; and machinery, railway supplies, manufactures of iron and steel, and flour for Korea and Japan, the United States is rapidly developing its sales.

While especial attention is given to the fact that merchandise cannot be successfully offered to an Oriental, unless it is of a kind to which he has been accustomed for generations, there are other important considerations which must be borne in mind. In no part of the East are there facilities of transportation such as those in the West, and goods which are to be sent to an Eastern market should be so packed that they can be conveniently and safely handled by the primitive methods in existence there. Not only does the climate necessitate special protection from excessive moisture and continuous heat, but the packages must be of such size that they can be conveniently handled from ship to lighter, from lighter to dock, and from dock to the shoulders of coolies, or swung upon poles reaching from shoulder to shoulder. Not only must the coverings, whether of wood, metal, or woven material, be sufficient to withstand the great strain resulting from continuous movements of freight on board a ship subjected to the vicissitudes of wind and wave, but they must also be able to withstand transfer from ship to lighter and lighter to dock and warehouse, by men who would welcome the destruction of the covering, in order to seize the opportunity to pilfer the contents of the package. Another fact which must be borne in mind is, that the Oriental, and especially the dweller in the Far East, has neither the wealth nor the habits of business which enable him to purchase for cash, and that those who expect to do business with him, must do so upon long terms of credit which can only safely be given through the presence of intelligent representatives. All these facts are important, and a full understanding of them is essential to success in trade with the East or with the tropics generally.

GERMAN CERAMIC INDUSTRIES.

The German industry and trade in ceramic ware, including bricks, has largely increased during the last thirty years, and the indications point to further expansion. Common clays which can be utilised for brick-making, and also those which can be used for the manufacture of common earthenware goods, are of frequent occurrence in almost every part of Germany. The rather superior kinds, and those which turn white after burning, are also common, but highly refractory clays are of rare occurrence. There are no very recent statistics available for obtaining a correct idea of the annual extent of the production of the various branches of German ceramic industry. The latest statistical returns are those furnished about five years ago, at the time of the preparation of the new German Customs tariff. These statistics were supplied to the Government by German manufacturers, and they may have been, in some instances, overstated, in order to give more importance to the respective branches of industry, and in some instances understated by manufacturers who were afraid that their figures might be used as a basis for increased taxation. Taking, however, these returns, the total value of the various productions of ceramic industry, exclusive of those of brick-making, in Germany in 1897, was £5,575,099. The total value of

porcelain ware alone amounted to £2,511,600, so that the total value of all ceramic productions of the more ordinary description, namely, stone-ware, earthenware, tiles, &c., amounted to £3,063,499. The total number of ceramic works, exclusive of those for brick-making, established in Germany in 1898, was 939, whilst the total number of workmen employed in them was 71,983. The total number of brick-making works in Germany, according to the last official census of 1895, was 16,431, and the total number of hands employed therein, 219,860. Amongst these brick-making works about 7,500 employed each not more than 5 persons, about 8,000 employed between 6 and 50 hands, and the remainder, namely, about 850, employed 52 hands and more.

If we compare the preceding figures with those given by the official census for 1882, it will be found that whilst the total number of hands employed in the German ceramic works, exclusive of brick-making works, in 1898 largely exceeded the number employed in 1882, the total number of the works had considerably diminished in 1898. This proves that the German porcelain and pottery manufacturers had come gradually to the conclusion that in order to cope in a profitable manner with the increasing demand, as well as in order to meet foreign competition successfully, it appeared judicious to concentrate their efforts by reducing the number of smaller works, and carrying on the work in factories established, wherever possible, on a large scale.

In addition to the well-known porcelain works which belong respectively to the Governments of Saxony and Prussia, namely at Meissen and at Berlin - Charlottenburg, and which have done so much for the general improvement and development not alone of the porcelain manufacture, but of the entire ceramic industry of Germany, there are at present about 200 private porcelain factories in Germany, and in addition to these, more than 1,000 other establishments occupied in painting, colouring, gilding, and otherwise "finishing" porcelain ware, but as a rule not employing more than 20 workmen. Whilst the Meissen and Berlin porcelain works manufacture chiefly articles of luxury, most of the German private factories produce porcelain ware for daily or technical use. The centres of the private porcelain industry, and of the finishing of porcelain ware, are in Thuringia, Silesia, Dresden, Berlin, Lower Bavaria, Baden, and in the Saar Valley.

The official returns of the exports and imports of ceramic ware respectively to and from Germany which have already been published for the year 1905 render it possible to form a rough estimate of the production during the past year. Considering that in 1897 the total value of the ceramic ware produced in Germany was £5,575,099, and of the exports in that year £2,875,900, thus leaving for consumption in Germany itself (exclusive of imported foreign ceramic ware) £2,699,199, Consul-General Sir William Ward, from whose report (653 Miscellaneous Series) we take these figures, concludes that the total production of Germany in 1905 must have been nearly twice as great as in 1897, that is to say, it must have exceeded £8,000,000 in value. The exports to foreign countries have increased since 1897 from £2,875,900 to £4,985,298 in 1905, whilst during the same period the annual total value of the imports has remained almost unchanged, it is evident, therefore, that the German domestic consumption of ceramic ware produced in Germany itself must have likewise experienced a considerable increase during the past eight years owing to the increased number and wealth of the population during this period.

Sir William Ward attributes the remarkable development in the export trade of German ceramic ware to foreign countries largely to the constant efforts made towards increasing the quality of the goods produced. The increase in quality which has taken place in German ceramic ware during recent years is attested by the fact, based on official statistics, that the average export value which was about 12s. per cwt. in 1891, rose to 18s. per cwt. in 1900. Apart from the opportunities which are offered in Germany by other technical schools of a more general character for acquiring a theoretical knowledge of ceramic industry in its various branches, there are at present four special technical schools for this industry, namely, at Hohr, at Bunzlau, at Lanbau, and at Landshut, all of which are situated in the midst of the industries which they are intended to promote. Their aim is to afford a thorough combined theoretical and practical workshop instruction, and to train young persons for future positions as owners, managers, foremen, painters, or modellers, in the various branches of ceramic industries. The schools are maintained by subsidy, and are under the supervision of the governments of the German States, in which they are situated. The statistics show that whilst, on the one hand, Germany imports from the United Kingdom large quantities of unglazed and glazed bricks, glazed earthenware pipes, muffles, and capsules, as well as of ordinary white stone ware, Germany, on the other hand, exports to the United Kingdom much larger quantities of coloured, painted, and gilt stone ware, and more especially white and coloured porcelain ware, in particular of coloured table services, and of fancy porcelain.

THE RICHES OF GUANAJUATO.

A production record of over one billion, five hundred million dollars, realised during three centuries of mining activity—then decay. More lately a complete revolution by the application of modern methods of mining, resulting in a yearly production of precious metal greater than in the times of its old bonanzas—that is the history, in brief, of Guanajuato, Mexico.

It is conservatively estimated by Mr. Dwight Furness, United States Consul, and an authority on

the subject, that before the end of this present year, Guanajuato, which four years ago was commercially a dead camp, will be producing gold and silver bullion at the rate of £14,000,000 annually; furthermore, that the maximum rate of production cannot be reached for several years to come. And for this there are four prime causes: modern transportation facilities; the installation of modern mining and milling machinery; electrically - transmitted water power, and the cyanide process of ore reduction.

Up to four years ago mining in Guanajuato was typically primitive and therefore costly. Below ground, the ore was carried on men's backs from stope to shaft, and it was raised to the surface in hide sacks. At the shaft head it was sorted by hand, and the richer grades only were packed on mule back to mills along the river bank. There it was treated by the old-time patio process—crude and expensive, which, while saving the silver values closely, lost half the gold.

Hundreds of thousands of rich slimes were let go into the river. It was an astonishing record of unnecessary expense, of wasted labour at every step. It is computed that the average saving for the district was 14 dols. 40 cents per ton, at an average cost of 13 dols. per ton. It was too close a margin, and mine after mine was abandoned, as, under existing circumstances, the limit of payable depth was reached. There were left standing in the old workings millions of tons of ore that would have been high grade in California or Colorado, while vast dumps containing millions of dollars became overgrown with vegetation.

In 1902, three Americans seeing the opportunity, and knowing the first need, acquired the right to utilise a water power at some falls 105 miles distant. The Guanajuato Power and Electric Company was formed, and within a year its works were completed. Power was for sale at the mines at 75 dollars per horse-power per year, where before it had cost over 200 dollars.

Other economies followed in rapid succession. Mines were equipped with modern hoisting and pumping machinery, and with labour-saving underground appliances of all sorts. Mills were built for the first time at the mines, cutting out transportation on mule back to patio mills in the city. By the successful adaptation of the cyanide process to Guanajuato silver-gold ores, after a long series of experiments, the revolution was complete. Mechanically, metallurgically, and industrially, modern methods had replaced the old throughout the entire system, with the result that to-day the average saving (bonanzas ores excepted) is estimated to be 15 dols. 56 cents, at a cost for mining, milling, and administration of 4 dols. 50 cents, leaving a profit of 11 dols. 6 cents a ton—a high net value when it is considered that the ore bodies are of exceptional width, and have in some cases been demonstrated to 2,000 feet depth.

The Guanajuato mines were worked long before the Spanish occupation. On the Peregrina, Rayas and Mellado properties are immense surface cuts where the Aztecs mined, building fires against the cropping, and suddenly cooling it with water. In this way, a body of ore, 650 feet long, 30 feet wide, and averaging 70 feet deep was removed on what is now the Peregrina vein. By these crudest of mining methods, the surface values were realised.

The Spanish occupation found the mining industry in Mexico in much the same state of depression that has been noticeable of late years, and for the same cause—that the limit of workable depth for the methods employed had been reached. By introducing European mining methods of their day, the Spaniards were able to realise extraordinary profits from mines that were no longer workable by the Aztecs. They sunk shafts, they reduced the ores, and to a certain point improved mining practice, with a resulting bullion production so enormous that during its continuance Spain was the dominant power, of which the whole civilised world lived in dread.

As the workings reached deeper levels and mining became more expensive, methods were not correspondingly improved. Modern mining science has found at Guanajuato, as at many other of the old camps of Mexico, a condition exactly parallel to that which confronted the Spaniards on their first arrival.

The methods which are now being so extensively applied to mining in this country, and as a matter of necessity for the utilisation of extremely low-grade but very large ore bodies compared to which the ores available in many parts of Mexico are high-grade. These methods have been applied almost, if not wholly, in their entirety at Guanajuato because of the vast quantities of ore available and ready for extraction from old mines, and because an obvious opportunity was grasped by men who were capable of profiting by it.

Guanajuato is probably the most beautiful mining city in the world. It has been chiefly dependent upon mining from its earliest beginning; and with continually recurring prosperity, as rich bonanzas were opened, its inhabitants have for centuries been lavish in expenditure upon public buildings, churches, and residences, among which are some of the finest specimens of architecture on the continent. It has 42,000 inhabitants. Surrounded by its mines, it stands as a remarkable monument to their permanency.

The existence of old mines which may be profitably worked by modern methods, is by no means the only cause for the present movement of American mining capital to Mexico. The Republic has an enlightened Department of Mines and Mining. Its laws are admirable and titles are safe. Labour is plentiful and cheap; and, above all, strikes are unheard of, almost inconceivable. Everything is done to encourage the investment of capital in legitimate enterprise and to hold it in security. The Government of President Diaz, realising that the vast mineral resources of the country needed more money for their development

than the Republic could conceivably supply, proceeded to attract it from other countries; the effort has been very notably successful.

To all who contemplate such enterprises, the present prosperity of Guanajuato, and the methods of industrial economy whereby it has been made possible, offer a profitable field for investigation—an example to be followed so far as circumstances may permit.

PHYSICAL EDUCATION.*

Education ought to consist in the development of faculties which would otherwise remain latent. In order to be complete it should consist of three parts—physical, mental, and moral—and in the arrangement of these parts the object of development should be kept clearly in view, and they should not be allowed to degenerate into processes of cramming or routine. The brain is the organ through which the mind acts upon the body, but the body also reacts upon the brain and on the mind, and, therefore, mental education cannot be regarded as complete unless combined with physical education. Mental processes are only rendered evident to others by muscular action, or sometimes, to a slight extent, by secretion, *e.g.*, tears. Muscles are set in action by nerves, which proceed from the nerve centres, spinal chord, basal ganglia, and cerebrum. The spinal cord presides over simple reflex action, the basal ganglia over complex involuntary co-ordinated movements, and the cerebrum over voluntary action. Physical education should be adapted to train all these structures:—(1) The muscles, by simple movements, frequently repeated; (2) the spinal cord and basal ganglia hy both simple and complex movements, such as those of gymnastic apparatus; and (3) the highest voluntary centres by games, and especially games of ball, or by the Japanese system of ju-jitsu, wherein all of which rapid judgment and decision are requisite. In order that these organs should remain functionally active they require free circulation of blood, and a free supply of air, and physical education requires training in respiratory movements and supervision of the circulation to see that no harm is done by over-exertion. Increased exercise also requires increased food; and not only must this be supplied in proper amount and proportion, but it must be digested and assimilated. Proper physical education is thus almost impossible without systematic medical inspection. A good deal of training may be done in rooms, but it is better carried on in the open air, and thus playgrounds are really as essential as schoolrooms. In order to obtain all the requisites for physical education, a good deal can be done by the Board of Education and county councils; but a good deal will still depend upon voluntary agencies, and it is most essential that these should be able to work together so that each one shall be aware of the best methods as followed by others, and there shall be no overlapping. It is the object of the National League for Physical Education and Improvement to bring all bodies working for the good of the people, into relationship with one another, and thus to ensure throughout the country a perfect system of physical education.

* Abstract of a paper read by Sir Lauder Brunton, M.D., F.R.P.S., before Section L of the meeting of the British Association, at York.

EDUCATION IN CHICAGO.

There are now 264,367 children enrolled in the public schools of Chicago, not counting about 50,000 in the parochial schools of the Roman Catholic Church. There are 260 schools with 5,100 teachers under the control of the Board of Education; the Church schools being separate and receiving no assistance from the taxes. Two new high schools for manual training have been started which are becoming very popular with boys, and tend to keep them longer at school. It is said whereas 35 per cent. of the lads leave the ordinary high schools during the first year, only about 15 per cent. drop out of the schools which give up part of the day to manual instruction. The average cost per head was in elementary schools £5 4s. 10d., high schools £12 8s. 5d., normal training school for teachers £63 12s. 8d. The boys in the seventh and eighth grade have manual training at a cost of 12s. 4d. a head., household duties for girls in the same grades 10s. 5d., drawing 4d., music 4d., German (optional), 1s. 7d., Latin (optional), 6s. 3d. Mr. Consul Finn, from whose report (No. 3622, Annual Series) these figures are taken, says that in the universities scattered through the district, many of them supported by taxation by the States in which they are, the number of students continues to increase, half of them at least being young women. The University of Illinois is about to have a department for ceramics, while the Chicago University proposes having one for railroad work. Cornell University, in the State of New York, has instituted a novel course in agricultural instruction. Many of those taking the course in the State of New York begin their practical farming in other States, where the conditions are very different, therefore a course of eight weeks has been offered by the University to students who will deposit £82 10s. each, out of which the expenses of a special railroad car, in which the students will live for two months, and the expenses of the instructor who will accompany them will be paid. Numbers of students at the different Universities work part of the day so as to pay either for their living or tuition. No child can be employed in the State of Illinois under 14, and if between that age and 16 must obtain a certificate from the Board of Education as to ability to read and write.

ARTS AND CRAFTS.

Modern French Designs for Silks.—In view of the decline in England of the *art nouveau*, the prevalence here in all kinds of decoration of that formerly discredited style so familiar to us under the title of Early Victorian, and the absence of traditional influence in original design, it is interesting to note the characteristics of modern French textile design as exhibited in the Exposition de la Soie, at Paris. The exhibition contains twenty-four cases in which are shown examples of the productions of the manufacturers of Lyons, Tours, and Paris, as well as a small but interesting collection of woven ribbons exhibited by the Chambre Syndicale des Tissus de Saint-Etienne. The exhibits include all kinds of silken fabrics, velvets, satins, damasks, brocades, brocatelles, &c., ranging from the thick, heavy brocades woven for State hangings for various royalties, by the Maison J. A. Henry, to the most fine and delicate of taffetas and other soft silks. The velvets form an important feature in the collection, and are remarkable for the freshness of their colouring, as well as for the strength and daring of the contrasts between the colour of the ground, and that of the pile. One length, showing green leaves on an apricot coloured background, is a quite wonderful piece of colour. There are also several very interesting specimens of velvets (most of them exhibited by Messieurs Cornille fréres) in four or even five colours. It is worth noticing, too, how the present demand for thinner and softer silks had led to most of the more striking and original designs being applied to these materials rather than to the stiffer brocades and damasks. Generally speaking, the colour effects are very bright and, at the same time, harmonious. Of course, silk is a material which lends itself more readily than other textiles to good colouring—but, making all due allowances for that, the taste shown in the choice and combination of colours is very marked. With regard to the patterns, there is very little in the way of historic design which strikes the observer as peculiarly French. There are, it is true, a few exhibits which are frankly Louis XVI. or Empire in style, but, with these exceptions, most of the silks and velvets which pretend to historic style at all go further back and are founded on early models, very often Italian. Another curious fact is that while there are many modern designs and a goodly number of copies or clever interpretations of old work, there is practically no original design which shows that the designer has much care for, or has been more or less unconsciously influenced by, traditional styles. On one side stand the copies and adaptations of old work; on the other the modern design, foliated or floral, sometimes with birds introduced; the bridges which span the gulf between the two are few and far between. The original designs, as we should naturally expect, are good, bad, and indifferent, but they are uniformly naturalistic in type, and they show a marked tendency towards that style which we have learned to associate with the name of M. Grasset. The book woven in silk throughout, exhibited by the Maison J. A. Henry, is interesting as a *tour-de-force*, but does not, of course, belong to the region of practicality. The rather shadowy engravings on silk—destined for use in book covers—seem to show a certain promise—but it is a little difficult to tell from a few specimens shown in frames how far they would be effective when really in use. The two cases devoted to the famous *rubans de Saint Etienne*, contain ribbons of all sorts—from the most up-to-date *chiné* and figured ribbons, and the most delicately and daintily coloured woven silk trimmings, to examples of weaving of a kind which we have come to regard as quite a thing of the past. The design of one or two specimens of this last type recalls one's childish memories of the old loom at the Crystal Palace, on which silk book-markers and such like were woven. The patterns, naturally, are of all styles and of none, and range from the simplest of the simple geometric borders of some of the woven trimmings, to figure subjects and elaborate floral designs.

English and French Glass and Pottery.—It is strange to see along what different paths artistic glass work is running on the two sides of the Channel. In England what is being done is practically all in the way of delicately-coloured, thin, blown glass—either after Venetian or Bohemian models or on new lines. Even the slight movement towards artistic cut-glass is in the direction of simple cutting on comparatively thin glass. In France, on the other hand, the current seems all in the opposite direction, the artists who are working in glass have turned their attention almost exclusively to thick and deeply-coloured vessels made in different coloured glass pastes and sometimes elaborately carved. (Cut has come to have so technical a meaning that this kind of cutting seems to be better explained by the term carving). The colour effect, which to start with is at times very happy, is often further enhanced by the addition of pastes of different colours to decorate various portions of the vases. M. Emile Gallé occasionally combines drops or "prints," both plain and elongated, with this kind of work with a very happy result. These drops, of course, are not in clear glass, but in colours which harmonise with the glass paste of the vessel itself. As regards pottery, French makers seem to have been working of late on much the same lines as the English potters, except that for the moment they appear to have given less attention to lustre. Some years back they were the pioneers in this direction, but the finest lustre is now undoubtedly being made on this side of the Channel. In both countries a good deal of attention is still being given to the production of crystalline glazes, and *flambé* has been attempted with more or less success—though in this case, again, it is the English potters who have brought it to the greatest perfection. At Sèvres they are bringing out crystalline glazes distinguished by the size of the crystals produced, while the porcelain

painting is largely on more or less naturalistic floral lines. M. Taxile Doat is producing work unlike other people—he is seeking after new chemical effects and also doing delicate figure work, sometimes glazed, sometimes unglazed, on a delicate celadon green ground.

Leather Bookbindings.—In leather bookbindings there is a note of difference between the practice of the two countries. Some years ago, there was a movement with us towards a new style of tooled bindings, accompanied by a tendency towards new, and in many cases eccentric, designs, but at present that is rather a thing of the past, and the English binders seem to have settled down either to ornamenting their covers with patterns which are either copies and adaptations of old designs, or to designing on certain rather restricted lines. It is not always easy to tell who is responsible for a given binding, though it would generally be fairly safe to say who was the designer's master. This, of course, means that apart from some rather interesting exceptions, which, however, hardly come under the head of tooled leather bindings, there has, of late, been little in the way of new departures. The tooling and inlay of our covers remain much as they were some years back, however much the level of technique may have improved. It is, therefore, rather interesting to note the use which is being made in France of inlay, not merely as a more or less insignificant adjunct to the tooling, but as the main point of interest in the design. Naturally this introduction of largish masses of another leather makes it possible to get more colour effect than we usually see in tooled bindings, and it seems more worth while to take the trouble to inlay broad masses of a different colour than to insert minute points here and there or even to put in long straight bands. The point that seems open to question is how far we can be certain (in view of the unsatisfactory way in which so much of the bookbinding leather is prepared) that after a few years the difference in tone which is so pleasing to-day will exist at all, or if it does, whether it will still be satisfactory. If we could only be sure of that we should wonder why English workers were not doing more on these lines.

NOTES ON BOOKS.

Systematic Inorganic Chemistry from the Standpoint of the Periodic Law. By R. M. Caren, D.Sc., and G. D. Lander, D.Sc. Blackie and Son, 1906.

This book is described as a text-book for advanced students reading for examinations, covering as it does the whole scope of inorganic chemistry, in 355 octavo pages. The work does not err on the side of verbosity. Undue condensation is, in fact, responsible for a few imperfect statements, which rather detract from the usefulness of the book as a source of information. Insoluble Prussian blue (p. 325) is not Fe'''—$[Fe''(CN)_6]_3$—but a hydrate of that substance. It would have been of interest even to examination students for the authors to have mentioned that Prussian blue cannot be obtained free from alkali unless hydroferrocyanic acid itself is used to precipitate the iron. The atomic weights given in the table on p. xviii. are calculated on the basis $H = 1$, which has been abandoned in favour of $O = 16$ in the latest international tables. This is certainly quite a matter of taste, but uniformity should be worth studying. The book is, however, a useful one, and although condensed, is not "scrappy." A really serious attempt is made at producing a systematic text-book of inorganic chemistry. Allied elements are considered in their mutual relations and the periodic law, which is, by the way, well enunciated and fairly presented both in its defective and its effective aspects, is made the basis of the author's scheme. Notwithstanding the somewhat restricted and academical nature of the information given in it, the book should be useful to a more extended class than it is primarily intended for.

Chapters on Papermaking. By Clayton Beadle. Vols. 1, 2. London: H. H. Grattan.

The first volume contains a report of a series of lectures delivered on behalf of the Battersea Polytechnic Institute in which the following branches of the subject are dealt with:—Fibrous raw materials; art papers as applied to process printing; bleaching; influence of moisture on paper; chemical residues in paper; function of water in the formation of a web of paper; permanence of paper; and sundry physical qualities of paper. The second volume contains chapters on technical education as applied to papermaking; on paper-sizing, and Answers to questions on papermaking set by the Examiners to the City and Guilds of London Institute.

The Year Book of Photography and Amateur's Guide for 1906-7. Edited by F. J. Mortimer. London.

This useful annual edited by the editor of the *Photographic News* contains a mass of information relating to the practice of photography, as well as advertisements, and is fully illustrated.

A Century of Copper. Statistical Review of the Nineteenth Century and the first five years of the Twentieth Century. By Nicol Brown and Charles Corbett Turnbull. Second Edition. London: Effingham Wilson.

In this pamphlet the price of copper, the production and the consumption (after 1841) are shown in

decennial periods. The highest price was during the decade 1801-10, when it brought £160 per ton, the lowest price was £55 during the decade 1891-1900. The production 1801-1810, was 162,500 tons, that in 1891-1900 3,706,940 tons. The countries that have produced over one million tons are Spain and Portugal 1,328,965, Chili, Bolivia and Peru 1,974,750, and the United States 2,993,540.

With respect to consumption the authors remark, "The problem of satisfying the increasing demand for copper is so urgent and important to electricians, that an attempt to enumerate the present sources of supply, and to investigate the capacity of such sources to maintain, and if necessary, to increase the output should be of special interest to them. But even if the existing output can be maintained, the further question presents itself: Can the new and increasing demand, likely to be made for electrical purposes, be satisfied from the present sources of production."

London: Historical and Descriptive. A Reading-book for Schools. By Ben Jonson. London: Blackie and Son.

This little book contains much information on the history of London, arranged in a chronological order, commencing from the earliest times, and coming down to the beginning of the twentieth century. Some of the etymologies of names are doubtful, and the etymology of London itself has never been settled.

The English Counties: a Series of Supplementary Readers.—Middlesex. London: Blackie and Son.

A convenient little handbook to Middlesex, which, with the book mentioned above, gives the school children of London information on the places where they live, which it is expedient they should possess.

OBITUARY.

Earl of Leven and Melville, K.T.—Lord Leven and Melville died at Glenferness-house near Forres, N.B., on the 22nd inst., after a long illness caused by a severe attack of influenza. He was born in 1835, and educated at Eton and Christ Church, Oxford. He was, until 1902, head of the banking house of Melville, Evans and Co., and for many years a director of the Bank of England and also of the Peninsular and Oriental Steam Navigation Company. He was elected a Scottish representative peer in 1892 and held the offices of Keeper of the Privy Seal of Scotland and Lord High Commissioner of the Church of Scotland. Lord Leven was elected a member of the Society of Arts in 1903.

GENERAL NOTES.

The Queensland Fruit Fly.—All fruit received in Victoria from Queensland, and parts of New South Wales, is being subjected to rigid examination, with the object of preventing the fruit fly, which is a native of Queensland, from obtaining a foothold. This fly (*Tephritis Tryoni*) is not quite as large as the common house fly. With a sharp ovipositor, the female deposits its eggs first under the skin of the fruit, and the larvæ soon burrow into the flesh and make the fruit so offensive as to be unfit for human consumption. Apricots, peaches, plums, cherries, oranges, bananas, and tomatoes are attacked by this orchard scourge. The fly is even able to drive its ovipositor through the thick skin of the pine-apple and deposit its eggs beneath. This destructive pest has been known for many years, but it is only during the last decade that it has become a menace to fruit growers. Spraying is of little value as the eggs are safely buried under the skin of the fruit. All that can be done in the way of suppression when the fruit-fly gets established in an orchard is to pick off and destroy infected fruit and treat the soil under the trees (where the grubs bury themselves) with a solution of sulphate of iron.

Ecuador.—Seven years have elapsed since the last general consular report from Guayaquil, and Mr. Consul Cartwright has much to say of interest as to what has happened in Ecuador in the interval. Guayaquil has suffered much from fires, and a few months ago an ex-President of the Republic carried through what Mr. Cartwright calls "a rapid and successful revolutionary movement." But, notwithstanding fire and sword, Guayaquil seems to be making some headway. Much of the town has been rebuilt; an adequate water supply has been secured; the streets in the burned districts have been widened to nearly 100 feet; no house may be built over two stories high, and there is absolute prohibition of pitch pine in the construction; an extensive sewage scheme for the city is being carried out, for which there would seem to be a great need; the population of Guayaquil has increased by 10,000 to 70,000 since 1899; and something has been done in the way of railway construction; indeed, Mr. Consul Cartwright says that "the opening of the railroad (to Quito) has materially assisted towards making the Republic self-supporting in the question of food products." The population of Quito is a little larger than that of Guayaquil, but the whole of the financial life of the Republic seems to centre in Guayaquil. Cuenca, the third city of the Republic, has a population of over 40,000, and has a considerable hat industry, but it is without communication by railroad. The principal products of Ecuador are cocoa, coffee, indiarubber, and ivory nuts, and there seems to be a great increase in the exports of Panama straw hats. British imports head the list if the average of the last five years is taken.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

SIR WILLIAM WHITE'S "MODERN WARSHIPS."

Sir William White's Cantor Lectures on Modern Warships have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

EXAMINATIONS.

The Results of the Elementary Examinations (Stage I.) were issued on Monday last, and copies have been sent to all Examination Centres for distribution to Candidates. The Examination Programme for 1907 will be ready in about a fortnight.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FIRE, FIRE RISKS AND FIRE PREVENTION.

By Professor Vivian B. Lewes,
Royal Naval College, Greenwich.

Lecture IV.—Delivered April 2nd, 1906.

We have seen that to create fire we must reach the ignition point of a combustible body in the presence of oxygen, the latter gas being present either in the air or in some oxidising compound, whilst to carry on the fire the supply of oxygen must be continued, and the temperature maintained above the ignition point, a failure in either of these requirements causing extinction of the fire.

We have also seen that with the exception of such fires as are caused by petrol, collodion, and a few other bodies of the same class which burn with such deadly rapidity as almost to defy checking, most fires have small beginnings, and are so easily dealt with in the earlier stages that unless they are given time to gather force their extinction is readily compassed, and it is this latter factor which is the most valuable asset in what is known as "fire prevention," but which is really "fire restriction."

We must have fire, but we must have it under control; we must limit its actions to our requirements, and we can only do this by, as far as possible, removing anything upon which it can feed from contact with it and, above all, prevent it from spreading from the area in which we are utilising it, or if by ill chance it should so stray, then having the means of dealing with it before it gets out of control.

There is nothing to which the old adage, "Prevention is better than cure," applies more aptly than to fire, and with the object of prevention in view enormous sums have been spent in the erection of what are called with grim humour "fireproof buildings," the absolute inutility and absurdity of which have been fully demonstrated by some of the biggest fires of modern times.

This disastrous state of things has been brought about by a complete misconception of what was really required to check the spread of fire, and by a bemuddled confusion of the terms "fireproof" and "fire-resisting."

In the first place, in attempting to lay down regulations for the erection of so-called fireproof buildings, the same scheme of construction has been applied to all classes of erections, from the suburban villa to the huge warehouse, and the man who would freely admit the fallacy of taking a digestive pill to cure a broken leg cheerfully believes in the efficacy of the methods that ensure safety in a small dwelling being adopted in a four-storied warehouse packed with inflammable material. The villa may be rendered practically non-flammable, but nothing can ever make a building fireproof that is stored with an immense amount of combustible material.

No building material that could be practically employed is "fireproof," *i.e.*, has the power of resisting the action of heat without undergoing a physical or chemical change. Granite and sandstone crack and fly under its influence; limestone, even at such moderate temperatures as 800° C., decomposes and

yields lime; bricks fuse, and so do iron and steel; and the result is that at the fierce heat engendered by a big warehouse fire, the most refractory materials prove themselves of but little resistant value, whilst the methods of construction employed make them an active danger.

I think the greatest practical lesson I ever received was whilst watching the big Cripplegate fire in 1899, seeing the marvellous way in which the flames spread over the area involved, and the way in which the fire passed from the buildings on one side of the narrow thoroughfares to those on the other with a rapidity that nothing could have checked, the spreading of the fire being entirely dependent upon the faulty methods of construction which had been employed in building. These methods have been perpetuated in the magnificent warehouses erected since on the same site, which, should a serious conflagration again occur, would spread the fire with even greater facility.

The warehouses are built in many cases with their walls and floors composed of bricks, iron, stone, and concrete, all of them substances which from time immemorial have been looked upon as those best adapted to resist fire. A highly ornamental front is then added to the structures, with anything up to 80 per cent., or more, of the frontage composed of glass windows. Glass, like the other materials used, is non-combustible, but if a fire breaks out in such warehouses, stocked in all probability with a large quantity of dry goods of the most inflammable description on fireproof floorings, the effect is that for a short space of time the combustion is penned into what is practically a huge retort. The heat then causes the glass to fly in every direction, a mass of flame is belched out laterally across the street, and on its first impact with the glass of the house opposite practically destroys it and leaves the goods within an easy prey to the devouring element. Moreover, the fire-proof materials of the ignited building soon prove themselves to be absolutely unfitted for the work they are called upon to perform They certainly do not burn, but at the first rush of flame the stone of the staircase and the lintels to the windows begin to calcine and fly to pieces. The stone staircase, keyed into the wall, cracks through, and probably comes down with a crash long before a wooden one would have been in any way seriously affected. The iron girders and ties also, as the fire increases, expanding with the enormous heat and contracting again as the water comes in contact with them, so strain the walls as soon to cause their fall, or else the iron girders, by twisting and warping under the influence of the heat, bring down the floors. The floors, made in heavy concrete sections, when they fall crash down through the floors below, and a fire in the upper stories of one of these so-called fire-proof buildings has often caused complete destruction of the whole building and loss of life, through the use of heavy concrete and iron floors and roof.

I have always been strongly opposed to the use of stone for staircases, as owing to the way in which stone cracks and splits under the influence of heat, it is an active danger, unless the stairs are supported upon iron grids which, even though the stone itself fly to pieces, will still leave steps for escape.

In criticising the use of iron and steel for columns and girder work in warehouses, the mistake is often made of speaking of the difference in expansion under the influence of heat as compared with the stone and materials of which the walls are composed, whilst in point of fact the actual difference in expansion between the iron and stone for a given temperature is very small. Over low ranges of temperature marble expands at the same rate as iron, whilst sandstone expands to an even greater extent, but neither of these materials could withstand a temperature of even 800° C., and then the marble would be disintegrated by its conversion into lime, whilst the sandstone, which consists of minute particles of sand luted together with calcium carbonate, is also disintegrated by the calcium carbonate burning to lime and setting the sand particles free.

The real fact which leads to the idea of the iron expanding in a much greater degree than the other building materials is that when a fire takes place the iron heating at one place to a high temperature, by conduction spreads its heat along the whole girder, and if this be 40 or 50 feet in length it will expand some four or five inches. The other building materials being excellent non-conductors, the heat is localised at one particular spot, and apparently hardly any expansion takes place. It is this considerable expansion over the whole length of the iron girder which gives the lateral thrust to the side walls into which it is keyed, and rapidly brings them down unless ample expansion spaces have been left at the end of the beam or girder.

In order as far as possible to obviate this

trouble all ironwork should be coated with a good insulator, care, however, being taken that everything is done to prevent corrosion under the insulating coating, as although cast-iron suffers but little diminution in strength from this trouble, steel and wrought iron are far more susceptible to it.

Other arrangements, apparently specially designed for helping on the progress of a big conflagration, are to be found in the lifts and light-wells present in nearly all warehouses and big buildings. The lifts especially form a channel up which the fire from any floor rapidly communicates with the rest of the building, whilst the large window spaces in the light-wells, should a fire break out in any room communicating with them, will rapidly lead to its spread.

In constructing a fire-proof building, what should be aimed at is so to build it of fire-resisting material that a fire accidentally started shall have but little or no danger of spreading, and that the maximum time should, therefore, elapse before the fire has assumed dangerous proportions.

In choosing materials for the construction of such buildings, the two great points that have to be aimed at are not selecting fire-proof materials, which are practically impossible to find, but non-flammable material, which is incapable of spreading a fire, and which itself is a good non-conductor; as it is clear that a partition or ceiling which is to prevent the passage of combustion from one compartment to another, should be of such a character that the heat cannot, by conduction, pass through it, an iron partition offering in reality far less safety than a wooden partition which, in spite of its inflammability and power of burning with flame, yet is an excellent non-conductor.

If we take the conducting power of iron as being 100, then brick would be about 6, timber 3, and cement 2. If now it were possible to render the timber non-flammable, *i.e.*, to prevent its burning with a flame on combustion that would pass on the ignition to other substances, it is clear that it would be superior to practically all other material except cement, which could not, of course, be used by itself.

Although timber, like all organic substances, is combustible, and will undergo destructive distillation when exposed to a high temperature, yet it can be treated in such a way as to render it flame-proof, so that the action of intense heat upon it is merely to char it, but not to set it on fire in such a way that it can spread the combustion.

It is now more than three centuries since attempts were first made to render timber used for ship-building fireproof, and from the early years of the seventeenth century down to the present time countless attempts have been made to protect wood in such a way as to prevent its being combustible. Hardly any of these attempts passed the experimental stage, and chiefly consisted of applying paints made with mineral matter, like silicates, for coating the surface of the wood. There were also many strange solutions for soaking it in before use, but all these attempts as far as fire-proofing is concerned ended in failure. It became evident that unless the protecting ingredient could be got into the structure of wood so as to permeate it to the core, and become part of the wood itself, a successful and satisfactory result was not possible of attainment.

In the last century Sir Humphry Davy and Faraday both attempted to solve the problem, and since then many scientific men have devoted considerable time and attention to it, but although it was easy enough as a laboratory experiment to render a splint of wood non-flammable, directly it was attempted on a commercial scale, complete failure was the only result.

The cause of these failures is not far to seek. Impregnation of a most thorough character is an absolute necessity, but every kind of wood has to be treated in a different way in order to meet the requirements of the varying densities, and as this depends not only upon the kind of wood, but also on the age of the timber and the character of the soil on which it grew, not only had the process to be varied with different specimens of timber, but also for different samples of the same timber when grown under different conditions, these being points which only now have been recognised.

A wide variety of substances has been suggested for fire-proofing, and the salts employed are now generally spoken of as "anti-pyrenes," but many of these have now been found to be absolutely unsuitable, owing either to their action upon the wood itself or upon the materials which had to be used with it. One of the most popular substances in the early experiments was common salt, but it was soon found that timber impregnated with this could not be commercially used because of its hygroscopic properties. Other substances then employed to effect the fire-proofing were found to rot the wood, whilst some very rapidly corroded the nails and screws used with the

impregnated timber. Other chemicals again, although they might do the required work for a short space of time, volatilised and left the timber as inflammable as it was before.

Practical experience has narrowed the list of efficacious compounds to ammonium chloride, ammonium phosphate, ammonium sulphate, calcium chloride, magnesium chloride, zinc chloride, zinc sulphate, stannous chloride, alum, borax, boracic acid, and aluminium hydrate.

In making the wood non-flammable, the timber is run on small trolleys into large cylinders in which, by means of a vacuum, all air and moisture are extracted from the cells of the wood, and the solution of the chemicals is then run in. The contents of the cylinder are placed under hydraulic pressure, carefully regulated according to the character of the wood, a pressure which is needed by one kind of wood crushing and destroying the cells of another. Indeed, the success of the whole process depends upon minutiæ of this kind, and the placing on the market of improperly treated wood has created a prejudice against such processes that has done much to retard its introduction.

After impregnating, the completion of which is indicated by the gauge glass on the cylinder showing that the right proportion of the liquid has been absorbed, the wood is removed, drained, and dried at a carefully regulated temperature, this again having a great influence on the quality of the finished wood, temperatures above 85° F. tending to render many kinds of wood brittle, whilst when dried at the right temperature the wood not only retains all its original qualities with the exception of inflammability, but is thoroughly seasoned and ready for the joiner's shop.

Made in this way non-flammable wood is a perfect building material, has no effect upon the workmen's tools, as was the case when the earlier antipyrenes were used, and will take paint, stains, varnish, or other decorative treatment as well as it did before fire-proofing. It now combines the dual advantages of excessively low conductivity with a great power of resisting fire, and entire freedom from spreading fire.

As before pointed out the cellulose of the wood is still there, and whilst a fierce flame is playing upon it this compound is carbonised, inflammable gases being generated and burning with small jets of flame, but the moment the heating flame is removed the charred mass blackens, and no spreading of the fire takes place.

This effect is caused by the chemicals used, consisting chiefly of ammonium phosphate and boracic acid which, during treatment, crystallise in the cells of the wood, and can, therefore, never be removed. Under the influence of heat the ammonium phosphate decomposes to ammonia gas and phosphoric acid, the former driving all air out of the cells and replacing it by a non-flammable gas, whilst the phosphoric and boracic acids fuse and coat the cell walls with a glaze which, while allowing the gases from the decomposing cellulose to escape, prevents the access of oxygen from the air to carry on further combustion.

Even should the apathy of the public and the greed of the speculative builder combine to prevent wood so prepared being universally adopted, its use should be enforced in all new hotels, public buildings, and places of entertainment, where it would afford more protection in case of fire than the multiplication of exits can ever do.

It is far easier, moreover, to treat fabrics than wood, as the cotton, consisting of minute tubes, will easily suck in and absorb a solution of the antipyrenes, when merely soaked in it, without the paraphernalia of vacuum cylinder and hydraulic pressure pump, and when properly prepared, it will take the colours as well as the original fabrics. With scenery so prepared and the use of flame-proof battens and stage, no fire to cause danger could take place.

The salts present in the wood prevent decay and dry rot, whilst an important advantage in its use is that its presence prevents the formation of pyrophoric char on wood exposed for long periods to the action of hot-water pipes, flues, &c.

The coming of the motor-car and motor-boat, and the rapid spread of electric traction, has created a new class of fire risk, unfortunately, more dangerous to life than to property.

The current necessary to drive an electric train is sufficiently powerful to work an electric furnace, and when owing to a faulty splice in the connecting wires on the cars, or other fault, a short circuit is produced, any inflammable substance exposed to the enormous temperature of the arc is at once set in a blaze, and the iron tube enclosing the wires is no more protection than a cardboard one would be, as the metal is melted away at once.

Now a train on fire at any time is unpleasant,

but when the fire takes place in an underground tunnel, where, if you escape the flames, you are suffocated by smoke, it is too awful to contemplate. The dreadful disasters which have taken place in Paris and Liverpool, and which have only been narrowly avoided in London on more than one occasion, should make the public for their own safety insist on a guarantee that the cars have been built of non-flammable wood before using the line. The District Railway has taken the precaution to do this, but how many non-flammable trains are running on other lines I am not in a position to say.

In the petrol motor-omnibus, also, the ignition of the petrol might lead to most disastrous results where the car was built of inflammable material, and nothing but non-flammable wood should be used for this purpose, whilst for motor-boats, in the navy, and for the woodwork of passenger and cargo steamers and war ships it would be of the greatest value.

In all cases, however, it is the question of cost which militates against the introduction of improvements of the most valuable kind, and with non-flammable wood the matter at first sight seems very serious. To impregnate the wood properly something like four lbs. of expensive chemicals have to be used per cubic foot. This, however, does not increase the weight of the finished wood, as it is more than made up for by the moisture withdrawn, and the result is that with cheap timber, such as the deals used for ordinary building purposes, the protection may cost as much as the wood, and if you are going to look upon the process as doubling the cost of the material, I admit the chance of getting builders to adopt it is small. I venture to submit, however, that this would be an entirely erroneous method of considering the question, and that the true way is to take the extra cost on the finished building or structure.

In any house, carriage or car, the amount of wood present is sufficient to ensure the total loss of the whole structure should the wood burn away. Now if you are building a car which will cost £1,000 when built with inflammable, and £1,100 with non-flammable wood, I think there are very few persons who would not prefer to spend the additional 10 per cent. for the certainty that it would save them the cost of the car in case of fire.

Looked at from this point of view I think it will be admitted that in all large buildings the increase on the gross cost would be so small as to make it almost a duty to adopt a measure that is not only for one's own safety, but for the good of the community at large.

Shortly after the great Cripplegate fire I was asked by Mr. Shean to give a lecture at the London Institution on the subject, and in dealing with the question of the building of warehouses pointed out that—

"A far more reasonable method of preventing fire is to give up the attempt to make the buildings absolutely fire-proof, and to make them fire-resistant, using only such materials as will require long and persistent heating and a high temperature before they are destroyed, and will cease to burn as soon as the external source of heat is withdrawn from them; whilst at the same time, in a big city, where the streets are narrow, partly from the value of ground space, and partly because they are the heritage left to us by our ancestors, the really important point is to prevent the fire spreading, as once given a fire well alight in a warehouse, it is fairly certain that if the stock is not destroyed by fire it will be by water. In such places the principles I would advocate would be that excessive window space should not be indulged in, and that the necessary windows should be capable of being automatically closed by iron shutters, worked from some point external to the building, and which could be lowered or closed directly the fire had passed the incipient stages. Given such an arrangement, and with the outer walls built of good sound brickwork, from which the ornamental stone lintels and tops to the windows have been discarded and good keyed-in bricks used, you would have practically a fireproof shell, and then if the stairs and floors were built of sound fire-resisting wood, and thickly painted on the under side with a good asbestos and silicate paint, whilst all floors, partition spaces, and stair backs were packed with silicate wool, you would have a structure from which the present dangers would be practically eliminated, and in the event of a fire getting thorough hold of the contents of such premises, the fire would burst its way upwards and find a harmless vent in the natural direction instead of being, as at present, directed against other valuable property.

"Many objections will of course be urged against such a scheme; the idea of shutters will be denounced as costly, cumbersome, and likely to get out of order, whilst it will be pointed out that window space is required for the escape or rescue of people within the building, and to give coigns of vantage from which to pour water on to the fire.

"The answers to these points are that the shutters would consist of sheets of thin steel, strengthened by small angle irons and hinged together in such a way that they would fold back to back into an area of about a quarter the window space, the whole being suspended at an angle to the upper portion of the window, and being arranged to act as a reflector to direct light from above into the rooms. On liberating a catch these flaps would fall, and by gravity draw the top section into a vertical position, the whole

forming a screen that would prevent the lateral outrush of a big volume of flame likely to be dangerous to the opposite premises, whilst they would offer no impediment to any one escaping from within, and the lower flaps could be raised for the entrance of hose. Employed in this way they would hardly be more costly than the reflectors at present used, and would afford an enormous protection against the spread of fire."

Since then wired or fire-proof glass has been introduccd which, although it cracks under the influence of fire and water, is retained in place by the wire netting fused into it. It would prevent the outrush of flame, and do away with the necessity for external shutters of the kind before advocated. This material should be used also for the glazing of all lift lights and the windows of buildings opening into light-wells in the centres of big blocks.

All lifts should be enclosed in non-flammable wells going upwards to the roof of the building, and being carried slightly above it. The roof should be of such light construction that in case of a fire breaking out on a lower floor and burning its way into the lift shaft, the flames would have free play upwards, and burning off the cover would escape harmlessly instead of being forced back to ignite the contents of the upper floors. All doors to the lift shaft should be non-flammable, and should close automatically.

In buildings to be used as stores for inflammable goods there is no doubt that subdividing the floors into compartments of reasonable size is a great help in fighting a fire, but for works where no large stock of inflammable material is kept restrictions as to size are vexatious and unwise, as for the successful carrying out of continuous processes of manufacture undivided ground space far exceeding that allowed by the regulations is often a necessity and entails no extra danger.

In the dwelling-house the use of non-flammable wood in the building, and for all doors and stairs, and the rinsing of the muslin curtains and draperies with a solution of ammonium phosphate and borax after washing would ensure the greatest amount of safety possible. In the country a chemical extincteur should be kept in a convenient position.

There is one point about theatre construction that I should like to bring to your notice, and in my opinion it is a most important one. As theatres are at present built, as soon as the audience is in the house there is always a strong draught from the stage into the auditorium, this being due to the main ventilating exits being above the auditorium, and as soon as the house grows warm the upcurrent created is so much stronger than any current existing behind the proscenium that all air currents set towards the auditorium.

The result of this is that should any fire take place behind the scenes, even with fire-resisting scenery, a certain amount of smoke is created, and although the fire-proof curtain may be promptly lowered, the smell of smoke at once finds its way into the auditorium and creates a panic which may cost hundreds of lives. Instead of having the ventilation above the chandelier or gallery a main ventilating shaft with strong updraught should be built above the proscenium party wall, with a chamber extending down each side of it to the top of the proscenium opening. With the ventilators on the auditorium side hidden among the designs generally found above the proscenium, and with similar openings on the shaft side, this point would be the main exit for hot air from both house and stage, whilst trunks should run from this chamber down each side of the proscenium with an open slot in them. In case of fire any smoke finding its way round the curtain would be sucked in by this and would never reach the auditorium. With high galleries a second ventilator would be necessary at the highest point of the roof over it, but would not give sufficient upsuck to draw smoke from the stage. The roof above the stage, however, should be made as light as possible, so that in case of a fire getting hold of the scenery, the flames could easily break their way upwards instead of being driven back into the auditorium.

When a fire is once well started the means that can be adopted for its extinction may be either by lowering the temperature of the burning mass below the point necessary for the continuance of the combustion, or else by cutting off all access of air, and so depriving the combustion of the oxygen necessary for its support.

To the first method belong the means usually adopted for extinguishing a fire, namely, that of pouring a large volume of water upon it. In doing so, several actions are brought into play. In the first place the temperature is reduced below the point of ignition owing to the large amount of heat absorbed by the water, and, secondly, as the water is heated up to its boiling point, an enormous volume of steam is generated which drives the air away from the burning material, and, lastly, the force with which the water falls on the burning mass

helps in extinguishing the fire by sweeping off the flame.

The amount of heat which water can absorb can readily be shown by placing a flame under a vessel of water in which a thermometer has been suspended. The thermometer steadily rises as the water gets hotter until the boiling point of the water is reached. At this point the mercury in the thermometer remains stationary, although the water is still being heated by the flame, and active ebullition of steam commences, and although the source of heat be increased by the addition of more burners below the vessel, no further increase of temperature is registered by the thermometer, the only result being a greater evolution of steam. The heat passing into the water is not lost, but is being used up in converting the liquid into the gaseous state, and experiments show that to effect this change as much heat is required as would have raised 536 lbs. of water one degree Centigrade, or 5·36 lbs. of water from 0° C. to the boiling point, 100° C. When the steam is once more condensed to water this "latent" heat is again given off. It is evident, therefore, that when water is poured on a fire the amount of heat absorbed is so great as to cool rapidly the temperature of the burning mass. It may be stated that roughly about five pounds of water will require the combustion of one pound of well-dried wood to effect its conversion into steam, and as in a fire it is only the surface of the wood that is undergoing combustion, the effect of the five pounds of water will be felt over a considerable area.

The steam generated occupies a volume of about 1,700 times as great as that of the original water, and as steam does not support combustion in the ordinary sense, the evolution of this enormous quantity of gaseous matter serves to drive off the oxygen of the air from the neighbourhood of the combustion, and so brings it to an end.

Although water will extinguish a fire, yet a certain amount of discretion is necessary in its application, otherwise unexpected results may happen. The water is required to wet and cool the burning material and to keep it below the temperature of ignition. If a stream of water be played into the lower portion of a large mass of red-hot carbonaceous matter, such as is often to be found in a big warehouse fire, the result is the formation of large volumes of inflammable gas, due to the decomposition of the steam by the incandescent carbon, which produces a mixture of hydrogen and carbon monoxide, the so-called "water gas" This mixture passing through the burning mass inflames at the top, adding to the conflagration, whilst if ignition does not occur, the gases mingle with the surrounding air and collecting under the ceilings and in the roof spans cause an explosion.

In order to avoid the formation of these gases, the water must be directed on to the top of the burning material first so that it cools the glowing carbon downwards, yielding the minimum quantity of inflammable products.

A fire can also be extinguished by practically smothering it, that is, cutting off all access of air and consequently oxygen, to the burning material. To aid this action all doors and windows should be kept shut.

In the case of burning oils and similar substances, the addition of water is of not much use, for the oil being lighter than the water floats on the surface and continues to burn. The best way of treating this is to throw on it mould or sand, or anything that will serve to keep the air away, and so smother the fire out. This method of procedure would be useful in the case of a lamp being upset in a room, as the mould from a flower-pot could be thrown on the burning oil and would stop the combustion by absorbing it and cutting off the supply of oxygen.

As we have seen in a previous lecture, certain gases have the power of checking combustion, and it has been attempted to utilise these gases to extinguish fires, but unless the whole of the surrounding atmosphere can be charged with the extinguishing gas little or no good results. When a fire is well alight in an open space, the upcurrent of hot air and products of production is so strong that any gas used for the extinction of the fire is at once swept upwards and draws fresh air on to the burning mass. In a confined space, however, this method has its uses. In the case of a chimney the combustion can be stopped by throwing a handful of sulphur on the fire in the grate, sulphur dioxide is generated, and rising up the chimney rapidly extinguishes the fire, whilst damp salt thrown on the fire in the grate acts in the same way by generating hydrochloric acid gas, which has strong extinctive properties.

The fact that such gases as carbon dioxide, sulphur dioxide, hydrochloric acid gas, and ammonia will not support combustion, whilst substances like salt and borax will fuse and form a protecting glaze that keeps oxygen away from a burning mass, has given rise to a

large class of chemical extincteurs ranging from the chemical fire engine to the hand grenade.

These may be divided into two classes, the first relying upon the rapid generation of carbon dioxide from carbonates and acids, in presence of a large volume of water, which absorbs the gas under the pressure created in the closed vessel in which the action takes place, this pressure also serving to drive the solution of the gas through the small hose and nozzle on to the fire. The water, as soon as it comes under ordinary atmospheric pressure, gives up its gas in the same way that soda water does, and this drives back the air, whilst the water cools the burning mass by its evaporation.

In such forms of apparatus the ingredients for the generation of the gas are generally carbonate of soda and hydrochloric acid which, when they come in contact, form common salt and liberate carbon dioxide. In small portable extincteurs there are several ways of mixing the ingredients ; in some cases the bottle containing the acid is placed in a cage in the top of the apparatus, whilst the carbonate is dissolved in the water, and on turning the extincteur over the acid and solution of carbonate mingle and the gas is evolved.

In other forms the bottle of acid is broken by a blow, whilst in the big two cylinder extincteurs fitted on a horse-drawn or motor-driven carriage, the acid is contained in a bottle covered by a lead capsule, which is pierced by moving a lever when it is required to put the apparatus in action. The two cylinder machines have the great advantage, that whilst one is in use the other is being recharged, so that a continuous stream can be kept playing on the fire.

The second class, to which all the hand grenades belong, contains chemicals which coat the burning mass, and at the same time give large volumes of extinctive gases.

My own experiments lead me to believe that the most effective of the many solutions that can be used for this purpose is a solution of sodium sulphate and ammonium chloride in molecular proportions. When this is thrown upon a hot fire the gases, sulphur dioxide and ammonia, are set free whilst salt is formed and glazes the embers.

Extincteurs and hand grenades have proved very useful fire appliances for domestic use, and whilst fires in an enclosed space are in their early stage, but are perfectly useless when a fire is raging fiercely and forming a strong upcurrent.

In ninety-nine cases out of a hundred, however, a fire can be rapidly and easily extinguished if it be attacked within a few minutes of its starting. A large proportion of serious fires takes place during the hours in which the warehouse is closed, or the occupants of the dwelling - house are asleep, and in order to meet these cases numerous automatic devices have been brought forward to cope with fire in its early stages.

In was in 1864 that Major A. Stewart Harrison first introduced the present form of sprinklers, in which easily fusible metal-plugs or attachments are melted by the heat, any serious rise of temperature opening the flow of water-jets or sprinkling arrangements on the walls, ceiling, and goods below. These sprinklers, however, have undergone many modifications since then, and many excellent forms now exist, but although adopted in a good many cases they have not achieved any very great measure of success in this country, a result partly due to the apathy of the owners of property, who are always unwilling to incur considerable initial expenditure over and above insurance for security from a chance of destruction of their property, especially as the feeling seems to exist in their minds that they might as well have their goods destroyed by fire as by water, whilst the spread of the fire to other people's premises is no business of theirs.

Sprinklers have been adopted to a far greater extent in America, where over 200 different forms are in use or suggested, whilst in England only some 8 modifications of the original idea have been employed.

The importance of time in the early stages of a fire is so great that a vast amount of work and ingenuity has been devoted to devising fire alarms which, on any sudden or undue rise of temperature, shall draw attention to the fact. Many of the more serious fires that have occurred have started in closed warehouses, and have smouldered and burnt for hours, the smoke escaping up the chimneys, so that no attention has been attracted until a tongue of flame has reached a window. Then the glass breaking air enters, converting the smouldering mass into a raging conflagration, when it is too late to do more than limit the area of the fire. It is in cases such as these that the use of good automatic alarms might save enormous loss.

The earliest forms of automatic alarms consisted of thermostats, which were practically

delicate thermometers, so arranged that abnormal rise in temperature caused the expanding mercury to make contact between platinum terminals, and so started the ringing of a fire alarm. These, however, frequently failed owing to the surface of the mercury or platinum becoming acted upon and affecting the contact. In order to obviate this trouble, liquids having a cleansing action were introduced above the surface of the mercury to prevent any amalgamation or oxidation and ensure contact.

One class of thermostat now in use is based on this principle, whilst a second kind consists of a closed tube containing mercury, above the surface of which in each limb a volatile liquid is confined, one limb being surrounded by an insulating sleeve. The effect of a sudden rise of temperature on this is to cause the vapour to form more rapidly in the uncoated limb, and this driving the mercury down opens a closed electric circuit, and closes a secondary circuit which transmits a signal to any desired spot. A differential thermostat is also used in connection with a second fixed temperature thermostat that remains stationary until a certain temperature is reached, and then has a long range for a small increase of temperature. After the first warning call has been given a further increase in temperature gives a fire call.

A third form of detector consists of a long copper wire stretched horizontally on a metal frame, which expands under the influence of heat to a far less degree than the wire, and causes it to sag in the centre and lower a suspended metal weight into a small mercury cup, thus completing the circuit and giving an alarm.

I do not wish to discuss the relative merits of the various systems, but must point out that in all such systems dependent upon electric currents, it is extremely difficult to ensure connections, &c., from getting out of order. Should a fault take place the whole apparatus fails, and constant testing is necessary to make sure that it is in working order. That is just what the owner will not take the trouble to do. For this reason I think the most valuable suggestion that has been made with regard to automatic fire alarms is to connect up a good indicator with the electric bells of the establishment in such a way that as long as they can be rung the apparatus can be guaranteed in working order. The bells are constantly in use and any failure at once becomes manifest, and as our own comfort is dependent upon getting it put right at once, it is done, and the alarm kept efficient.

In concluding these lectures I can only express my regret at the limitations which time has placed upon my treatment of the subject, and can only hope that the labours of such excellent bodies as the Fire Prevention Committee may tend to bring home to the British public how much remains with them to do for the protection of their homes and trade interests. After every great fire calamity a flickering interest in fire prevention springs up for a few days, and as quickly dies out, leaving the property owner quite content to trust his protection to chance and to our splendid fire and salvage corps. If only the County Council, through their Fire and Technical Education Committees, would popularise the subject of fire prevention amongst the public, and make them see the importance of the matter to themselves and the community at large, the enormous tax in lives and property now exacted by the fire fiend could soon be very largely reduced.

FOREIGN LABOUR STATISTICS, AND INDUSTRIAL ORGANISATIONS.*

This valuable report of some 350 pages sets out a great mass of information concerning wages paid in different countries to various grades of wage earners, hours of labour, trade unions, trade disputes, conciliation and arbitration, workmen's and accident insurance, old age and infirmity assurance, and cooperation.

In the collection and comparison of statistics relating to wages, many difficulties manifest themselves. Methods of collection and presentation vary, while in some cases complete returns are only available for a single year or short series of years. Therefore, before reviewing the returns from individual countries separately, a few words may be said about wages-rates which are strictly comparable. Differences occur in various countries as to the classification of wage earners. There are, however, certain occupations which are more or less the same in different countries, such being bricklayers, masons, carpenters and painters engaged in the building trades, and blacksmiths, turners and pattern makers in the engineering trades. The question of earnings is also mixed up with that of the time actually worked; in the following paragraphs therefore, which relate to strictly comparable occupations, the hourly wages and normal hours worked per week are given.

Bricklayers.—The highest paid bricklayers are

* Compiled from the Third Abstract of Foreign Labour Statistics (Cd. 3120). Printed by Darling and Son, Ltd., Bacon-street, London, E. Price 1s. 6d.

those in the United States, where the hourly wages vary between 2s. 3d. in Boston (48 hour week), to 3s. $1\frac{1}{2}$d. in San Francisco (44 hour week). Intermediate rates of 2s. $8\frac{1}{2}$d. per hour are paid in New York for a 44 hour week. For Great Britain, the rates ruling in eight large cities are given:—London is the highest at $10\frac{1}{2}$d. per hour for a 50 hour week, and Bristol and Bradford lowest at 9d. per hour, the working weeks being respectively 54 and $49\frac{1}{2}$ hours in duration. German rates vary from $5\frac{1}{2}$d. per hour in Mainz (60 hour week) to $8\frac{1}{2}$d. in Berlin (53 hour week). The highest rate of pay in France is paid in Paris ($7\frac{3}{4}$d. per hour for a 54 hour week), and the lowest in Lille and Toulouse ($3\frac{3}{4}$d. per hour in each place, the working week being 57 and 60 hours respectively). Much lower wages are paid in Italy, where the standard working week for this class of labour is 60 hours. The rates per hour recorded are $3\frac{3}{4}$d. in Milan and Turin, $3\frac{1}{4}$d. in Rome, and 3d. in Bologna. For Norway, only one rate is recorded, that of $6\frac{3}{4}$d. per hour in Christiania for a 60 hour week. Remuneration in Holland varies from $5\frac{3}{4}$d. per hour (63 hour week) at the Hague, to $4\frac{1}{2}$d. per hour (64 hour week) at Utrecht. In Amsterdam, the rate is $5\frac{1}{2}$d., and the week one of $58\frac{1}{2}$ hours. Belgian rates vary from $3\frac{1}{4}$d. in Ghent and Antwerp, to $3\frac{3}{4}$d. in Brussels, the length of the week not being stated.

Masons.—The highest paid masons are those in the United States, where the rates are less than those earned by bricklayers; 2s. 1d. per hour is a common payment in New York, Chicago, and Philadelphia; 2s. $4\frac{1}{4}$d. is reported from St. Louis, and 1s. 10d. from Boston. In Great Britain, wages and hours of labour are practically identical with those of the bricklayers. In Germany the rates are generally less, there being two schedules, indoor and outdoor. In Berlin, these are $7\frac{3}{4}$d. and $8\frac{1}{2}$d. respectively, Bremen and Hamburg $8\frac{1}{2}$d. and $9\frac{1}{2}$d., and Chemnitz $4\frac{1}{2}$d. and $4\frac{3}{4}$d. In France wages are slightly higher than those paid to bricklayers, being $8\frac{1}{4}$d. in Paris, $6\frac{1}{4}$d. in Havre, and $4\frac{1}{4}$d. in Toulouse. In Holland, the rates are identical with bricklayer's pay at Amsterdam and Rotterdam, but one halfpenny per hour cheaper at the Hague, and one farthing per hour dearer at Utrecht. The Belgian rates are $4\frac{1}{4}$d. at Brussels, $3\frac{1}{4}$d. at Antwerp, and $3\frac{3}{4}$d. at Ghent.

Carpenters.—There is again a wide margin between the rates ruling in American cities, the maximum reported being 2s. $2\frac{1}{2}$d. in New York and the minimum 1s. $6\frac{1}{2}$d. in Boston. English rates vary from $8\frac{1}{2}$d. in Bradford to $10\frac{1}{2}$d. in London, the rate in Liverpool, Manchester, and Birmingham being $9\frac{1}{2}$d. German rates are $8\frac{1}{2}$d. in Berlin, $7\frac{3}{4}$d. in Hamburg, and $5\frac{1}{2}$d. in Mannheim. French rates are $8\frac{3}{4}$d. in Paris, $5\frac{3}{4}$d. in Marseilles and Rouen, and $4\frac{3}{4}$d. in Lille, Toulouse, and Nantes. The highest Italian rate is 3d. per hour in Rome, Milan, and Turin (60 and 63 hour weeks), and the lowest $1\frac{3}{4}$d. per hour in Bologna, where the working week is 66 hours long. Dutch rates vary from $5\frac{1}{2}$d. in Rotterdam to $4\frac{1}{4}$d. at Utrecht. Belgian rates are lower, the highest being $4\frac{1}{4}$d. in Brussels and the lowest $3\frac{1}{2}$d. at Ghent. Only one Norwegian rate, that of 6d. per hour at Christiania, is recorded.

Plumbers.—The English rate of pay is 9d. in Leeds, Bradford, and Bristol, $9\frac{1}{2}$d. in Liverpool, Manchester, Glasgow, and Birmingham, and 11d. in London, the working hours varying from 47 to 54 per week. In the United States, the lowest rate is in Baltimore, 1s. $8\frac{1}{4}$d.; in New York the rate is 2s. 4d., while the highest rate is 2s. $7\frac{1}{2}$d. in San Francisco. The working week is from 44 to 48 hours. In Germany, the hours are longer and rates lower, typical cases being Berlin $7\frac{1}{4}$d. ($53\frac{1}{2}$ hour week), Breslau $5\frac{1}{4}$d. (59 hour week), and Mainz, $4\frac{1}{4}$d. (57 hour week). The highest French rate is $7\frac{1}{4}$d. in Paris (60 hour week), the lowest being at Lille, $3\frac{3}{4}$d. (60 hour week). Other rates are Havre, $6\frac{3}{4}$d. (57 hour week), Marseilles, 5d. ($60\frac{1}{2}$ hour week), and Nantes, $4\frac{1}{4}$d. (60-hour week). In Holland, 5d. is paid in Amsterdam for a 60 hour week, and $4\frac{1}{2}$d. at Rotterdam for a 64 hour week. The Belgian rates are $4\frac{1}{4}$d. at Brussels and $3\frac{1}{4}$d. at Ghent, the hours of labour not being stated.

The wages of *plasterers*, *painters*, *tilers* and *slaters* are similarly set out. They need not be recited in detail. Passing to the engineering trades, some very interesting figures are furnished relative to blacksmiths, turners, and pattern-makers.

Blacksmiths.—Highest wages are paid in the United States, where 1s. $6\frac{3}{4}$d. is paid in New York, 1s. $7\frac{1}{2}$d. in San Francisco, 1s. $4\frac{1}{2}$d. in Chicago, 1s. $3\frac{1}{2}$d. in St. Louis and in Philadelphia, 1s. 3d. in Boston, and 1s. $1\frac{1}{4}$d. in Baltimore. The hours of labour vary from $53\frac{3}{4}$ to $54\frac{3}{4}$ hours per week. London wages are the highest in Great Britain, being $8\frac{3}{4}$d. in London (54 hour week). Liverpool ranks next at $8\frac{1}{2}$d. (53 hour week), Manchester and Birmingham at $8\frac{1}{4}$d. (53 hour week). In Leeds, the rate is $7\frac{3}{4}$d. (53 hour week). No German rates are given. French rates are—Paris $8\frac{1}{4}$d. (60 hour week), Havre, Nantes, and Lyons $6\frac{1}{4}$d. (60 hour week), Marseilles $5\frac{1}{4}$d. (60 hour week), Lille and Rouen $4\frac{3}{4}$d. (66 hour week). Only one rate is given for Holland, that of $3\frac{3}{4}$d. (66 hour week) at Rotterdam. The Belgian rates are $4\frac{3}{4}$d. at Brussels and $3\frac{1}{4}$d. at Antwerp, the hours of labour not being stated. One Norwegian rate is given, namely, $5\frac{1}{4}$d. at Christiania for a 57 hour week.

Turners.—The London rate is $8\frac{3}{4}$d. for a 54-hour week; $8\frac{1}{4}$d. is paid in Liverpool, Manchester, and Birmingham for a 53-hour week; 8d. is paid in Bristol for a 54 hour week, and $7\frac{3}{4}$d. in Glasgow and Bradford for 54 and 53 hour weeks respectively; $7\frac{1}{2}$d. is paid in Leeds for a 53 hour week. In the United States, the San Francisco rate of 1s. $5\frac{3}{4}$d. is the highest, the working week being one of 54 hours. In New York and Chicago 1s. 3d. is paid for $63\frac{3}{4}$ and 54 hour weeks respectively. The St. Louis rate is 1s. $3\frac{1}{4}$. (54 hour week). Other American rates are—Boston, 1s. $2\frac{1}{4}$d. ($54\frac{1}{4}$ hour week); Philadelphia,

1s. 2d. ($55\frac{1}{2}$ hour week); and Baltimore, 1s. 1d. (54 hour week) No German figures are given. As regards the French rates, no figures are published for Paris. The highest rate recorded is that of $6\frac{1}{4}$d. for a 60 hour week at Havre. Other rates are—$5\frac{3}{4}$d. Lyons (60 hour week), $5\frac{1}{2}$d. Nantes ($60\frac{1}{2}$ hour week), $4\frac{3}{4}$d. Lille (66 hour week), and $4\frac{1}{4}$d. Marseilles (60 hour week). The rates in Holland are—$4\frac{1}{4}$d. at Rotterdam (64 hour week), and $3\frac{1}{2}$d. at Utrecht (72 hour week). One Belgian rate, that of $4\frac{1}{4}$d. at Brussels, is given.

Pattern-makers.—The London rates are stated to be $9\frac{1}{2}$d. and $9\frac{3}{4}$d. Other British rates are—Manchester, 9d.; Liverpool, $8\frac{3}{4}$d.; Birmingham, Leeds, Bristol and Bradford, $8\frac{1}{2}$d.; and Glasgow, $8\frac{1}{4}$d. The weekly hours of labour are 54 in London, Glasgow and Bristol, and 53 at the other centres named. In the United States, 1s. $8\frac{1}{2}$d. is paid in San Francisco, 1s. $7\frac{3}{4}$d. is paid in New York, 1s. $6\frac{1}{4}$d. in Chicago, 1s. $5\frac{3}{4}$d. in St. Louis, 1s. 4d. in Baltimore and in Boston, and 1s. $3\frac{1}{2}$d. in Philadelphia. The hours worked per week are 56 in Philadelphia, $55\frac{3}{4}$ in Boston, and 54 in the other centres named. No French, Belgian, or German rates are given. As regards Holland, piece work is general in Amsterdam and Rotterdam, but the predominant time rates are 4d. to $5\frac{1}{4}$d. in Amsterdam, $4\frac{1}{2}$d. in Rotterdam, and 4d. in Utrecht. The hours of labour are 54-66 in Amsterdam, 64 in Rotterdam, and 67 in Utrecht.

Growth of Trade Unions.—In countries of progressive industrial development trade-unionism makes a steady and, in some cases, a rapid growth. The extent to which workers in different countries belong to trade unions of course varies. The total recorded membership of trade unions in 1904 is reported as follows:—

United Kingdom	1,866,755
Germany	1,466,625
France	715,576
Austria	189,121
Denmark	90,111
United States—	
(Federation of Labour)	1,675,400
(New York State)	391,681

With regard to the United Kingdom it may be noted that there was a large increase in membership between 1896 and 1901, when the numbers rose from 1,503,739 to 1,940,874. Latterly there has been a slight decline. In Germany the numbers enrolled have risen from 864,350 in 1899 to those given above. The French figures for 1899 give a membership of 419,761, while the Austrian figures for the same year were 119,344. There is no particular change in the Danish figures. In the United States, the Federation of Labour membership was 349,422 in 1899, and 1,024,399 in 1902; the membership in New York State was 209,020 in 1899 and 329,101 in 1902.

Detailed tables show that certain trades are more strongly organised than others, the tendency to organise being greatest in the case of skilled labour. The largest tra^de societies in Germany are those o the building trades, the metal industries coming second with a membership nearly equal to that of the building trades. In France, by far the largest unions are those of the transport trades, the metal, mining, and textile trades ranking next. In Austria, the metal trades are most influential, the building and transport trades having fewer members. In Italy, one-half of the organised workers are connected with agriculture, the transport trades following with one-seventh and the metal workers with one-tenth.

As regards finance, the following figures give the income per member in the cases named:—

	£	s.	d.
Norway (all unions)	1	6	6
Germany (Social Democratic unions), slightly under	1	0	0
Hungary (all unions)	0	13	3
Austria (all unions)	0	12	0
Germany (Hirsch-Duncker unions), slightly under	0	10	0
Germany (Christian unions)	0	6	6

It is stated that in only two cases does the total balance in the hands of the unions amount to as much as one year's income.

Trade Disputes.—The following table gives in a summarised form the information for the latest year in each case:—

Country.	Year.	Number of work-people affected by disputes.	Aggregate duration of disputes in working days.
United Kingdom	1904	87,208	1,484,220
United States	1900	567,719	figures not available.
Germany	1904	145,480	
France	1904	271,267	3,936,774
Italy	1903	131,834	1,881,145
Austria	1904	73,528	666,658

Looking over the series of years covered by this publication, it is pleasing to note the decline in duration of British labour disputes since 1901; the numbers of workpeople affected have declined since 1902. In Germany, during the depression of 1901, there were relatively few disputes, only 68,191 workpeople being affected in that, and 70,696 in the succeeding years. Since then the numbers have increased. The French figures are so oscillatory, being alternately high and low, that no general tendency can be noted. The Italian figures show a decline from 1901, while the Austrian figures as to trades disputes have closely followed the German figures already alluded to.

LEAD MINING IN YORKSHIRE.*

The general subject of lead mining in the North of England has been somewhat exhaustively dealt with, both mineralogically and geologically, by various writers, but hitherto the historical side of the question

* Abstract of a paper read by James Backhouse before Section F. (Economics) of the British Association, York, 1906.

for any given county has not been systematically treated.

In 1863 the late Mr. Thomas Sopwith F.R.S. read an admirable paper before this Association on the local manufacture of lead, copper, zinc, antimony, &c. Tracing as he did the general history of the mining of those metals in the various districts, especially of the North of England, it was obviously impossible to particularise on any one metal, but as a general epitome the article was absolutely reliable.

In 1848 a paper was read before the Yorkshire Philosophical Society, and published in their Transactions, entitled "Thoughts on Ancient Metallurgy and Mining in Brigantia and other parts of Britain." While giving an excellent summary of our knowledge of early mining in the country, it does not attempt to define any special area or set of mines. More recently Mr. Stephen Eddy has written upon the "Lead Mining Districts of Yorkshire," mostly from a geological standpoint, but where statistics are given they are of much value.

For many years Yorkshire held a most important place as a lead-producing district, and it is probable that during the palmy days of the industry at least 3,000 persons were employed, directly or indirectly, in lead mining in the county. To-day there are probably not more than 25 all told!

It is clearly proved that lead has been mined for many centuries in Yorkshire, not only in Roman, but in Brigantean times. Pigs of lead can be shown, found in Yorkshire, bearing the Roman impress. In the 'baile,' or 'bole-hills,' and probably in one or two drifts and shafts, we have evidence of Brigantean working; some of it possibly dating back earlier than the Roman invasion.

In many districts tradition points to Roman mining, but evidence is not forthcoming to show whether these conquerors actually mined lead themselves or whether they begged, borrowed, or stole it from the subjugated tribes

From those times, however, through what we may call the early documentary period, lead was mined more or less systematically in Yorkshire, often in large quantities, and there can be no doubt also at a large profit.

But we have to deal especially with the lead mining of the nineteenth century, and to consider briefly to what extent the industry has been carried on in recent times.

The actual area in which lead has been mined in Yorkshire may be taken as about one-sixth of the entire county, and is situated in the North and West Ridings, in the mountainous regions towards the head waters of rivers—the Tees (where it divides Yorks from Durham and Westmoreland), the Yorks Lune, the Swale, and its great tributary, Arkle Beck, the Ure, the Nidd, the Wharfe, the Aire, and the Ribble. Taking these districts *seriatim*, commencing in the north, we find that the Tees area contained some thirteen or fourteen distinct mines; none worked since about 1870. Lunedale has about half-a-dozen, one of which, that known as Lunehead, was extensive, and has been reopened recently. For the next two areas—those of Arkengarthdale and Swaledale—it is impossible at the moment to register any definite number, but they may be said to have run into the hundreds at one time or another.

Two especially, Hurst Mine, in Arkengarthdale, and that at Old Gang, in Swaledale, were notorious for centuries, and the output from them was enormous.

From the latter mine it is said that at one time, about the middle of the nineteenth century, some 3,000 tons per annum were produced. At Hurst the Romans are said to have had a penal settlement, and lead was probably mined there, not only by them, but who shall say how long before? Now Hurst is grim and desolate like the "Deserted Village," though the hills still cover thousands of tons of rich ore, which twentieth-century enterprise may yet acquire. Old Gang, in Swaledale, is still kept going, but is gradually becoming worked out; though there can be little doubt that many other veins in its proximity may be worked to profit at to-day's selling price if facilities for carriage were provided.

In Wensleydale, over the ridge southward we find at least forty distinct mines, and some of these were very remunerative, notably that of Keld Heads, near Wensley. Flooding of the mine at a time when the market price was very low was the cause of closure.

This mine, along with several others, was closed down during the last decade of the century. Continuing southward, in Nidderdale about thirty separate mines have been wrought, those on Greenhow Hill being once among the oldest and most productive in the north of England; Cockhill Level (Greenhow) branched into many miles of levels, from which a great weight of lead was taken; yet the supply is by no means exhausted, for the Bradford Corporation, when recently making their pipe track across Greenhow Moor, cut a very large vein of ore. Mr. Joseph Cradock, J.P., of Stockton-on-Tees, still works at Lolly Scar and Blayshaw Gill Mines in this area.

Wharfedale contributed enormously in the middle of last century from some twelve or fifteen mines, of which Grassington Moor Mine was by far the most important. They were closed some thirty years ago.

Of Airedale but little need be written, for, with the exception of the great Cononley Mine, there were only a few lesser trials.

In the last area, that of Ribbesdale, three mines were worked, namely, at Rimmington, Skelhorn, and two in the Bolland district near Slaidburn.

Skelhorn Mine was worked centuries ago, and was rich in silver, like many of the Yorkshire mines.

So far as can be ascertained there are possibilities for future enterprise in nearly all the areas mentioned, but prospectors will do well to observe the causes which led to the close of the various workings before. Briefly they are as follows:

(*a*) The continued low price of lead, largely influenced by Spanish importation.

(*b*) The spirit of mine speculation in the worst

sense of the term, whereby the mines were bought up and floated for the sake of immediate gains from their floatation.

(*c*) The system of remuneration of the miners themselves having been changed from the "bing system" to the "fathom system."

(*d*) The fact that landlords in many districts purposely put difficulties in the way of miners on account of the value of their lands for grouse-rearing, and because of the pollution of their rivers owing to the lead-washing.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in July:—

New Charts.—3580—Wales, west coast; Fishguard bay. 3494—Norway, west coast; Giaeslingerne light to Dolm sund, including Folden fiord. 3465—Baltic, Little Belt; Trælle nes to Aarö sund. 3579—South Atlantic ocean; South Georgia. Plans: —Royal bay; King Edward cove; Moltke harbour; sketch of Cumberland bay. 3573—Plans on the coast of Chile:—Antofagasta; Hornos cove; Coloso cove. 591—United States, west coast; San Francisco harbour (preliminary). 27—Persian gulf; Abu shahr (Bushire). 3574—Malacca strait; plans on the east coast of Sumatra; Langsar bay; Langsar river entrance; Birim river entrance. 3283—Plans in the Philippine islands:—Salomague harbour and Lapog bay; Port Kurrimao and Gan bay. 1288—China:—Plans in the Yang tse Kiang; Chin Kiang fu and Silver island; Se Yun Kau creek to Silver island. 3565—New Zealand, north island:—Bream head to Tepaki point (Mercury bay), including Hauraki gulf. 2527—New Zealand, sheet III.; Mayor island to Poverty bay. 3576—Fiji islands:—Namuka harbour; Nai Toni Toni and Veivatuloa anchorages.

New Plans and Plans added.—2114—Baltic entrance, the Kattegat. Plan added:—Anholt harbour. 1596—Harbours and anchorages on the coast of Italy. Plan added:—Port Sorrento. 1221—Labrador; harbours and anchorages in Hudson bay and strait. Plan added:—Hebron bay. 1282—Chile, sheet VII., Lora point to Maitencillo. Plan added:—Port Lapallar. 1300—Plans on the coast of Chile. New plan:—Port Papudo. 2732—Plans of anchorages in Bali, Lombok, &c. Plans added:—Grajagan bay, Pangpang bay. 2873—Anchorages in the Solomon islands. Plan added:—Ngora fu harbour.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—871—England, south coast:—Tamar river. 2364—Germany, north coast:—Lübeck bay and Fehmarn belt. 2789*h*—River St. Lawrence, Sheet XXI.:—Cole shoal light to Rockport. 2806—United States, east coast:—Charleston harbour. 554—South America:—Magellan strait. 1289—Chile, Sheet IV.:—Guaitecas islands to Cape St. Antonio. 1325—Chile:—Gulf of Peñas to the Guaitecas islands. 3447—British Columbia:—Moresby passage with its approaches. 1922—British Columbia:—Fraser river and Burrard inlet. 1501—Alaska, Aleutian islands:—Seguam island to Attu island. 655—India, west coast:—Port of Bombay. 2455—Andaman islands:—Stewart sound. 975—Philippine islands:—Port Kavite. 1578—Japan:—Simonoseki strait. 2460—Pacific ocean:—Kamchatka to Kadiak island, including Bering sea and strait.

These charts are issued by Mr. J. D. Potter, 145, Minories.

CIGARETTE SMOKING.

The report of the Select Committee of the House of Lords on the Juvenile Smoking Bill is a strong confirmation of the views of the Committee on Physical Deterioration which sat a couple of years ago upon the harmful effects of cigarette smoking when indulged in by children and others not adults. The Committee support their opinion by a series of recommendations of a drastic kind. They recommend —1. That every person who knowingly sells or delivers or permits or supplies to be sold or delivered any description of cigarettes to any child under the age of 16 years shall be liable to a penalty of 40s. for the first offence, and of £5 for any subsequent offence. 2. That every child under the age of 16 found in possession of cigarettes, or found smoking tobacco in any form, shall be subject to a penalty of 40s. for each offence, and to the provisions of the "Youthful Offenders Act, 1901." 3. That police constables shall be empowered to stop all youths apparently under the age of 16 seen smoking in any public place, and to confiscate any tobacco found upon them. 4. That local authorities shall be allowed to extend some of these powers to park-keepers, school masters and others, by means of by-laws; while similar powers might be given to railway and dock companies on their own premises. Lastly, the Committee are of opinion that the pernicious consequeuces of cigarette smoking should be brought before the Board of Education, and that the attention of teachers should be directed to the importance of the question. It is difficult, says the report, to exaggerate the influence of these teachers, or the excellent results of the work which has been done during the last thirty or forty years in all our elementary schools. The Committee think, therefore, that the teachers should be invited to point out from time to time the bad effects of cigarette smoking in stunting growth and in producing disease. In this way the Committee hope that a public opinion would be created among boys which would materially stop the habit, and go far, in conjunction with the legislation on the lines which they have suggested, to decrease an evil which threatens to do so much harm to the manhood of the country.

HOME INDUSTRIES.

The Harvest.—Harvest operations may now be said to be over except in the north, and both in quality and quantity the corn harvest, which has had good weather for the ingathering, leaves little room for complaint, with the exception perhaps of spring oats. The saying that "heavy corn is good corn" receives fresh illustration from the samples of new crops in the market, but prices are less satisfactory. And unfortunately the hop crop in England, and the potato crop in parts of Ireland, are very deficient. The fruit crop too is disappointing, although the fine weather of August has done much to improve the apple crop, which will be a good one, the deficiency being in pears and plums, and some kinds of small fruit. The preliminary statement of the total acreage under all crops just issued by the Agricultural Department shows that the anticipation indulged in some quarters last year that the great expansion of wheat cultivation shown in 1905 would continue, has not been realised, owing mainly, no doubt, to the unfavourable weather at seed time. In 1905 the total acreage under wheat was 1,796,995, this year it is only 1,755,716, a decrease of 41,279 acres, or 2·3 per cent. Oats show a fractional decline of 0·3 per cent., or 8,450 acres, and peas of no less than 12·1 per cent. or 21,256 acres, but the acreage in barley has increased from 1,713,664 acres to 1,751,238 acres, or 2·2 per cent., and in beans from 254,765 acres to 288,891 acres, or 13·4 per cent. It is noticeable that notwithstanding the immense crop of last year the acreage under hops has fallen from 48,967 acres to 46,722 acres, or a decrease of 4·6 per cent. In 1905 the yield per acre was the highest on record, namely 14·21 cwts., but the year was anything but a profitable one for the hop grower, the cost of picking being necessarily very heavy, and prices leaving no margin of profit. This year the yield will be as low as last year it was high, and the expenditure upon the vines in battling with the blight has been exceptionally heavy. In past years a great advance in prices has amply compensated for a small crop, and present Continental reports point to a somewhat short yield. but home reserves are the unknown quantity. It is satisfactory to note that the small increase in fruit cultivation continues this year, the acreage being increased from 78,825 acres to 80,226 acres, or 1·8 per cent., which has been about the usual rate of increase for several years. It is to be regretted that the Agricultural Returns do not differentiate the various kinds of fruit, so as to enable the increase or decrease in each description to be noted. The total acreage under all crops and grass in the United Kingdom is less this year than last, but the decrease is only some 20,000 acres, or 0·1 per cent.

Imitation Woollens.—The action of the Board of Trade in prosecuting a tailor for selling spurious Harris tweeds has been generally commended, and it may be hoped that the sentence of two months imprisonment will act as a salutary check upon other tailors. It is to be desired that the Board of Trade will not be content with the one prosecution, but will proceed with the campaign against spurious goods until the evil practice has been reduced to the smallest possible dimensions. It is an old and great grievance this spurious imitation of Scotch and Irish specialities, and West of England cloth. Indeed, the same complaint applies to the silk and other industries. Is it impossible to analyse garments bought by the public in the same way that their food is analysed? The Food and Drugs Act has done much to eliminate adulteration, although a more stringent application of the Act is desirable. Why should not similar action be taken in the matter of clothing? The Belfast Linen Association is moving in the matter of linen by making it clear that those who retail collars, cuffs, &c., and call them linen when, as a matter of fact, there is little or no linen in them, will have to reckon with the law. The Irish Industrial Development Association has also been protesting with success against the practice of marking articles "Donegal Tweeds" when in fact they are made in Yorkshire mills. But Government action would seem to be necessary if the evil is to be dealt with effectively. It should be as easy to detect the adulteration of woollen goods by cotton, or of silk by mercerized cotton, as to detect adulteration in foods. How much, for example, of the cloth sold as "West of England" really comes from that district? It should not be assumed that the tailors who sell the spurious goods are always to blame. They do not usually buy their cloths direct from the manufacturers. Their practice is to get it from merchants, who may sell them as genuine "Harris," or "Donegal," or "West of England" cloths, the product of districts far remote from these places, although probably in most cases the tailor has a shrewd suspicion that the article is not what it professes to be. Be that as it may, the practice is one that requires to be grappled with, and probably can only be effectively combated by official action. It has been suggested that all goods should be stamped with the manufacturer's name, and with a description of the material with which the goods are made. The valid objections to the suggestion are not apparent, and its adoption should go far to assist the public in avoiding spurious goods. Some such plan, with the persistent prosecution of offenders, might be expected to do much to lessen a legitimate grievance not only of the public but of the honest trader.

Shipping Mortality.—The summary of vessels totally lost, condemned, &c., published by Lloyd's Register, shows that in 1905 the effective marine of the world was reduced by 883 vessels of 792,354 tons, figures that do not include vessels of less than 100 tons. The tables show that the percentage of losses to vessels insured, 4·47, was a little higher than the average for the five years preceding, 4·42, and that 41·6 per cent of the losses of steamers, and 41·3 per cent. of the losses of sailing vessels, were due to

strandings and kindred casualties. The next most common cause of disaster was by condemnation, 22·3 per cent. of the steamers, and 27·3 of the sailing vessels removed from the mercantile marine during the year being accounted for in this way. Collision, 9·7 per cent. for steamers, accounts for the next largest percentage of removals, and from 8 to 9 per cent. of the sailing vessels are accounted for under the heads of missing and abandonment. Taking the cases of abandoned, foundered, and missing vessels in 1905, collectively they comprehend 20·4 per cent. of the steamers, and 22·2 per cent. of the sailing vessels removed from the marine register in that year. The British loss compares favourably with the average of the losses sustained by foreign countries. The percentage of British steamers lost during 1905 was 1·34, while the average percentage of the United States, the British colonies, France, Germany, Italy, and Norway, that is of all the other countries whose merchant navies exceed 1,000,000 tons, was 1·55. It is noticeable that the percentage of loss among the sailing vessels is appreciably higher. In the United Kingdom it was 3·37, and for the other six countries 4·14.

Omnibus Traffic.—It is too soon to form definite conclusions as to the comparative cost of electric and horse-drawn omnibuses, but the accounts of the London General Omnibus Company and the London Road Car Company, now presented, although they do not enable an exact comparison to be made, supply certain information of interest. One point made clear is the great cost of repairs. At the end of June the London Road Car Company had 94 motor cars and 435 pair-horse cars, the former being an increase of 73, and the latter a decrease of 85, as against the same date of 1905. The 94 motor cars cost the large sum of £30,800 for repairs and renewals, and £7,700 for motor fuel and lubricants, the total car expenses being increased by over £23,000. The company carried 776,000 more passengers than in the corresponding six months of 1905, but it added only £5,400 to its gross revenue, and the dividend fell 2½ per cent. The London General Omnibus Company was slower in resorting to motor omnibuses, and the result upon its passenger traffic was very marked. In the six months it increased the mileage run from 16,484,000 to 16,652,000, an increase of 168,000 miles, but, making allowance for the steady growth of its passenger traffic prior to the introduction of the motor omnibuses, it carried something like a million passengers less, and the receipts fell by over £25,000, with a consequent drop in dividend of 2 per cent. These figures are decisive evidence of the popularity of the motor omnibus, but those of the London Road Car Company would seem to show too that the expense of running will be considerably increased, and that the companies will have some difficulty in earning dividends unless they raise fares. It may surprise many to learn that the total expenses of the London General Omnibus Company practically equalled its revenue from traffic, the expenses being £579,258 while the traffic receipts were £579,646. The net revenue of the company was derived from advertising and from interest and dividends. The reports of the new motor omnibus companies have not as yet been published, but there is no reason to suppose that their outlay upon repairs and renewals is less than that of the older companies. It is probably greater seeing that their vehicles were the pioneers, and the newer cars are said to be not only better constructed, and less offensive in the matter of noise, smell, and vibration, but also more durable.

Electric Tramways.—Passing to electric tramways, Mr. H. E. Garcke has just published some interesting figures bearing upon the great difference between the original estimates put forward by tramway promoters respecting the cost of construction and operating expenses and actual results. He takes a number of estimates on which the adoption of the trolly system in this country was based, and compares the expectations formed with the results which have been achieved. These estimates work out at £9,500 per mile of single track and the operating expenses at 5·30d. The results actually achieved were substantially different. The capital expenditure has been over £12,000 per mile of single track, against the £9,500 estimated. The working expenses are 6·3d. per car mile, instead of 5·3d. per car mile. Or, to put in another way, the average costs of working per route mile in operation are £3,100, as against the estimated figure of about £2,600. The wear and tear, too, have proved to be more serious than was anticipated, and from this point of view Mr. Garcke puts the difference between the estimated and the actual working expenses at more than one penny per mile. There is, however, a wider margin to work upon than with the motor omnibus, and the general expectations with regard to gross revenue have been very nearly realised. It was assumed that the effect of electrification with the overhead system would be reduction in fares, a more frequent service, greater speed than in the case of horse traction, a considerable increase of traffic receipts per route mile, and a substantial reduction of working expenses. It may be said that, on the whole, these expectations have been realised, but in some cases, and in some respects, they were too optimistic. Mr. Garcke shows how important are small economies in working expenses. An additional gain of one halfpenny per car mile, in the form of either increased revenue or reduced expenditure represents on the 240 millions of car miles run during the year covered by the last return a gain of £500,000 per annum, which is equal to nearly 1 per cent. on the entire capital expenditure.

Fire Insurance Offices and Foreign Business.—The stringent earthquake clauses have saved British offices doing business in Chili from the heavy losses that would have fallen upon them otherwise conse-

quent upon the recent earthquate disturbances, and which were so serious in the case of San Francisco. But the South American disasters give additional interest to some tables published by *The Times* (August 27) dealing with the conditions under which fire insurance is carried on by British companies in the United States. A complete list has been compiled of the commitments of British fire offices and their subsidiaries, the latter often being large, and their transactions materially affecting the proportion of the United States businesses to the total operations of British companies. The figures for the United States are taken from the official Green Books. The Royal and Queen, whose premium income, derived from the United States, is larger than that of any other company, may be taken as fairly representative of the whole. Its total premium income is given as £3,054,216, and the portion of it derived from the United States at £1,662,990, or 54 per cent. Its fire reserve funds (excluding capital) are put at £4,200,340, and the proportion in the United States at £2,686,835, or 63·9 per cent. This is higher than the average of the eighteen offices whose figures are given, which works out at 49·4, but the Liverpool, London and Globe is 68·6, and the Scottish Union and National is no less than 134·4. Again the Royal and Queen's proportion of premium derived from the United States, 54·4, is higher than the average, 43·2, but the Liverpool, London and Globe is as high as 64·4. Turning to the profits made by British fire offices in the United States during the ten years, 1896-1905, it is shown that the losses in San Francisco wipe out the probable profits of twenty years. "In the returns to the New York State Insurance Department, the British companies are required to set up reserves for the whole of their unexpired premiums —without deductions for expenses and profits." Allowing the customary 40 per cent. of the increase in premiums during the decade as sufficient provision for the increase in liabilities, the net profits of the British offices and their subsidiaries work out at £4,420,863, or 5·7 per cent. of the premiums. The net losses of the same companies in San Francisco are estimated by themselves at £9,045,582, or more than twice the above profits. In the case of the Royal and Queen, the net profit on their American business in the ten years was £988,676, their net declared loss in San Francisco £1,157,555. The Liverpool, London, and Globe made a net profit in the ten years of £1,033,485, and lost at San Francisco £799,600; the Commercial Union and its subsidiaries made a profit of £608,148, and a loss at San Francisco of £823,256; the London Lancashire and Orient made a profit of £444,111, and a loss of £845,944. Taking the whole eighteen companies they showed, as stated above, in the aggregate a net profit in the ten years of £4,420,863, and a loss at San Francisco of £9,045,582. These figures bring out two points very clearly, the different treatment accorded to British offices in the United States in the matter of provision to meet unexpired premiums as compared with British State requirements of American offices doing business in this country, and the doubtful abiding advantage of the American business of British offices.

GENERAL NOTES.

"SUNN" HEMP.—The Acting Superintendent of the Royal Botanical Gardens at Calcutta gives in his Annual Report the following note on ineffectual attempts to cultivate this plant. "Sunn" hemp (*Crotalaria juncea*)—seed of which was obtained from all parts of India where it is grown—was again cultivated in small plots. It was thought that by sowing fairly late towards the end of October, better results than those of last year might be obtained. As it turned out the result was the reverse of what was expected. Almost all the plants began to flower when little more than a foot high, and they obstinately declined to grow much higher. On two occasions every plot was flattened out by heavy rain, which did not tend to improve matters. As far as yield of fibre is concerned, no results which could be relied upon could be obtained from plants which behaved in such a manner. As the cultivation of "Sunn" hemp is likely to prove of very considerable importance to India, it is proposed to continue plot experiments until some definite results are obtained, or until the Agricultural Department can take up the experimental cultivation on a larger and more satisfactory scale than is possible on the very limited amount of ground available in the garden.

THE TRADE OF PERNAMBUCO.—The most important points to be borne in mind by British exporters to Pernambuco, says Mr. Consul Staniforth in his report on the trade of the district (Cd. 2682) is (1) to send out travellers knowing the language of the country with abundant supplies of samples; (2) to send catalogues printed in Portuguese only and giving metric weights and measures; (3) to study lightness as far as possible in the goods selected for export, and above all in their packing, as the Customs Duties are levied by weight; (4) to encourage the utmost care to ensure the absolute accuracy of consular invoices, as the most trivial discrepancy is liable to be visited with a very heavy fine. The trade of the district last year was very bad. "Of a series of six unfortunate years 1905 has been the most disastrous, and this notwithstanding an exceptionally fine crop of sugar, which is the staple industry of the district. Prices left no margin of profit. Fluctuations in exchange, too, which averaged over 1s. 4d. for the year, as against 1s. for 1904, disorganised commerce," and Mr. Consul Staniforth says it would be prudent on the part of British manufacturers and exporters to be cautious in their commercial transactions with Pernambuco, whether as regards embarking in new enterprises, or the opening or extension of credit.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

"OWEN JONES" PRIZE.

This competition was instituted, in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Committee of the Owen Jones Memorial, being the balance of subscriptions to that fund, upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Board of Education, South Kensington.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The following is a list of the successful candidates:—

Bignall, Percy, School of Art and Design, Nottingham.—Design for a Lace Curtain.

Eckersley, Mabel, School of Art, Carlisle.—Design for Tiles.

Massey, John W., Technical School, Glossop.—Design for Cotton Prints.

Potter, Stanley B., School of Art, Macclesfield.—Design for a Woven Silk Hanging.

Shaw, John T., School of Art, Carlisle.—Design for a Stencilled Hanging.

Walker, Charles, Literary and Scientific Institute, Coalbrookdale.—Design for Tiles.

The next award will be made in 1907, when six prizes will be offered for competition.

PROCEEDINGS OF THE SOCIETY.

HOWARD LECTURES.

HIGH-SPEED ELECTRIC MACHINERY,

WITH SPECIAL REFERENCE TO

STEAM-TURBINE MACHINES.

By Professor Silvanus P. Thompson, D.Sc., F.R.S.

Lecture I.—Delivered January 18th, 1906.

The Problems of Electric Design as affected by Speed and Rated Output.

Many factors enter into the problem of the economic generation of electric energy. Leaving aside the utilisation of water-power, wind-power, and tidal-power, the cost of fuel, and the economics of distant transmission, it remains to be true that the economic generation of electric energy is dependent on the cost of the prime power which serves as source, and this again depends on the type of prime mover adopted. If we assume steam as the medium by which the heat energy is to be translated into mechanical energy, and further, in any given case that steam at a given temperature and pressure is produced at a given cost per pound, then the chief economic questions which remain to be dealt with are the type of engine and the type of electric generator to be adopted, the size of unit of each, the nature of the electric supply as to whether alternating or continuous, and the appropriate voltage, together with the appropriate frequency and phasality if alternating. In many cases these latter electrical conditions are settled in advance, leaving as the main points to be decided the type of engine, the type of generator, and the size of units. Now, into any decision on these points there necessarily enters as a consideration of prime importance the question

of speed; or rather perhaps one ought to say of speeds, for the speed of the generator is not necessarily the same as that of the engine which drives it. It is obvious that in the case where the prime mover is a gas-engine, an oil-engine, a water-turbine, or a steam-turbine, questions as to the most economic speed both of prime mover and of electric generator also arise.

When in the seventies electric lighting first began to assume a commercial aspect, no engineer appears to have dreamed of driving a dynamo by any other method than by applying a pulley to its shaft, and belting this pulley to a pulley on the shaft of a steam-engine either directly or through some countershaft. It is true that in the Great Exhibition of 1862, Holmes, the first engineer to apply electric lighting to English lighthouses, showed his magneto-electric machine driven direct on the end of the shaft of a steam-engine running at 110 revolutions per minute. But his example was not followed by those who came after. The steam-engines of that day were almost without exception slow-speed engines, while the early dynamos required high speeds; and there was no choice but to drive by gearing or belts. The state of steam-engine practice at the end of the seventies appears nowadays truly remarkable. If we except the locomotive and marine types of engines as being out of consideration for the purpose, we are left with the types of stationary engine then in vogue for pumping and blowing, for the driving of textile factories and rolling mills. Winton's well-known text-book "Modern Steam Practice and Engineering," which went through several editions, gives a remarkable view of the practice as it obtained 25 years ago. In the edition of 1883 the typical examples of stationary engines are instructive. On p. 288 there are described the engines of the Dowlais Iron Works; a blowing engine of 650 nominal horse-power, making 22 R.P.M., and a rolling engine of 1,000 nominal horse-power, making 24 R.P.M., both working with steam at 40 lbs. per square inch. On p. 300 is mentioned a 160 horse-power engine at the Royal Gun Factory at Woolwich, making 21 R.P.M., and also taking steam at 40 lbs. per square inch. As a novelty is mentioned the compound engine, working the rolling mill of the Steel Company of Scotland, at Hallside, near Glasgow, built by Miller, of Coatbridge. This was of 3,000 horse-power, at 50 to 60 R.P.M., and using steam at 120 lbs. per square inch. Smaller steam-engines undoubtedly ran faster; but the practice then was totally different from that of to-day.

On the other hand the early dynamos were of small power, and ran at high speeds in order to give the required voltage. A report of Trinity-house, in 1877, gives particulars of seven machines tested at the South Foreland Lighthouse by Professor Tyndall and Sir James Douglass. The following Table gives the data of them:—

	Weight.	H.P.	R.P.H.	Cost. £
Holmes	5,747	3·2	400	550
Alliance	4,081	3·6	400	495
Gramme (No. 1)	2,856	5·3	420	320
Gramme (No. 2)	2,856	5·75	420	320
Siemens (large)	1,306	9·8	480	265
,, (small)	420	3·5	850	100
,, ,, ...	420	3·3	850	100

It may be of interest to add a few data of subsequent years:—

Messrs. Siemens Bros., 1882.

No.	Horse-power.	R.P.M.	Price. £
D_5	1½	1,200	45
D_3	2½	950	65
D_2	4	600	95
D_1	7	550	220
D_0	15	500	290
D_{00}	20	400	360

The Gülcher Company, 1883.

No.	Horse-power.	R.P.M.	Price. £
1	2½	1,500	80
2	4½	1,300	100
3	7½	1,100	160
4	13½	900	250
5	25	700	450
6	50	550	800

Messrs. Paterson and Cooper, 1882.

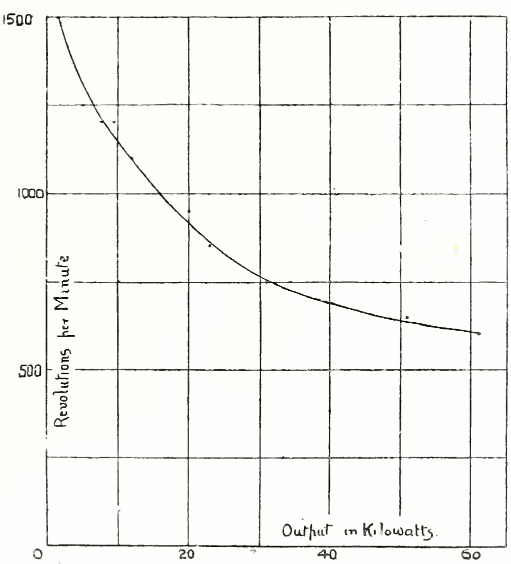
No.	K.W. output.	R.P.M.	Price. £
1	0·96	1,800	36
2	1·9	1,700	54
3	4·0	1,600	80
4	6·4	1,500	120
5	12	1,200	180
6	20	1,050	250
7	32	900	400

Such high speeds as those indicated above could not be met except by belt driving. There were indeed exceptions, for Messrs. Goolden and Co. brought out in 1888 a line of dynamos principally for ship-lighting driven by high-speed Brotherhood engines. Their catalogue gives the following data:—

Goolden and Co., 1889.

No.	KW. output.	R.P.M.	Weight.	Price.
				£
A	$1\frac{1}{2}$	1,500	420	36
B	3	1,450	450	45
C	5	1,250	672	70
D	$7\frac{1}{2}$	1,200	900	88
E	$9\frac{1}{2}$	1,200	1,120	118
F	12	1,100	1,350	125
G	16	1,000	1,800	150
H	20	950	2,130	170
I	23	850	2,480	200
K	31	750	3,250	240
L	35	700	3,700	260
M	51	650	5,280	300
N	61	600	6,300	400

Fig. 1.



Relation between Output and Engine-speed of Brotherhood-Goolden Sets (1888).

Fig. 1 gives the data of output and speed plotted as a graphic curve.

The pictures of projected central stations of the early eighties are most instructive. They usually show a single large steam-engine driving a main shaft from which a large number of small dynamos are driven by belts, with or without countershafts. The great majority of early American stations were actually fitted upon this plan. The photographs now shown are the designs of Mr. Edison and Mr. Weston respectively, and emphatically stamp the engine practice of that date. Nevertheless it was foreseen that, sooner or later, direct driving must supersede belt driving, and this tendency made itself evident in various directions. Mr. Gordon, when designing the electric lighting plant for Paddington Station in 1882, constructed two-phase alternators direct-driven from engines of massive type, each unit being of 420 horse-power at 164 R.P.M. These engines and the alternators have been in continuous work from 1883 to the present date. At the Vienna Exhibition of 1883, Messrs. Ganz surprised the engineers of that time by producing a fly-wheel alternator. That is the alternator was built with a revolving field-magnet having a crown of radiating poles projecting from the rim of the fly-wheel of a large horizontal engine. The horse-power was 120, the speed 230 R.P.M. About the same date, as recorded in vol. iii. of the American Society of Mechanical Engineers, Mr. Edison designed his "Jumbo" pattern of dynamo for direct-driving by a Porter-Allen engine, using steam at 120 lbs. per square inch from a Babcock-Willcox boiler. The indicated power was 168·4 horse-power, the speed 350 R.P.M., and the total weight of the dynamo 44,820 lbs.

These were, however, exceptions. In the United States, hundreds of lighting stations grew up in which the most conspicuous feature was the leather belting: for the engine builders had their standard slow-speed engines, and the dynamo builders their standard high-speed dynamos, and neither would go out of their way to adapt their manufactures to the needs of the other. The large stations, such as the West-end Station in Boston, in the early nineties, were marvels of engineering at cross-purposes.

It was clear that development might come in either of two directions: either the electric generator might be designed to suit the slow-speed engine, or the engine might be designed to suit the high-speed generator. The former of these courses prevailed on the Continent, particularly in Germany, where the large slow-speed type of generator was evolved by the houses of Siemens and Halske, Schuckert, and the Helios Company, as well as in Austria by Ganz, and in Switzerland by the Oerlikon Company. The use of water turbines for the hydraulic stations in Switzerland greatly influenced the development of slow-speed generators of large diameter, and led to the adoption of the "umbrella" type of design which originated with Charles E. L. Brown, and was repeated in the Niagara machines. The Berlin type of generator, with its singular

inversion of construction, having the ring armature inside the commutator and the field magnet inside the armature, was the extreme outcome of this movement. Questions of centrifugal force and of commutator friction limited the surface speed of the commutator. In a machine such as those at the Schiffbauerdam station, with their imposing Van der Kerchove engines of 1,000 horse-power, at 60 to 75 R.P.M., with a commutator 10 feet in diameter, the surface speed cannot well exceed 1,800 to 2,250 feet per minute.

In the meantime a development of the opposite kind was going on in England. Crompton, Siemens, the Brush Company, Messrs. Elwell and Parker, and other firms, were securing the co-operation of engine builders to produce high-speed engines, and the tendency was accentuated by the introduction of higher boiler pressures. Headed by Messrs. Willans and Robinson and by Messrs. Bellis and Morcomb, British engineers struck out lines of new design, and produced reciprocating engines suitable for the demand of the moment, of high speed and of small power. For in those precious years of the eighties progress in England was hampered, and all schemes involving large units discouraged by the incubus of Mr. Chamberlain's disastrous Electric Lighting Act of 1882. It was not until 1888, when the injury wrought to the industry by this interference with trade had become unendurable that this Act was repealed. It was several years before the evil effects of this legislation were so far mitigated as to admit of any very general demand for large units. And so it came about that long after Continental engineers had adopted large multipolar units ranging from 700 to 1,500 kilowatts in their central stations, the British central stations were being filled with rows of little bi-polar dynamos of 200 to 300 kilowatts, each driven by its own little Willans or Bellis engine. Those who remember the Paris Exhibition of 1889 will recall the very miscellaneous styles and types of generators and of engines there exhibited. Even Mr. Ferranti, the Brunel of electric lighting, though he designed a direct-driven 10,000 horse-power alternator which was destined never to reach completion, had to resort to rope-driving in his pioneer station at Deptford, for the 1,000 kilowatt alternators needed a speed of 120 R.P.M., whilst the marine engines were designed for 75.

With the adoption of alternating current distribution, and particularly after the introduction of polyphase plant, the demand for large units increased in every part of the world; so that the Frankfort Exhibition of 1891 and the Chicago World's Fair of 1893 saw a great change in progress. With the increase in scale of the generator a type of engine came into demand much more nearly resembling the marine type.

By the time of the Paris Exposition of 1900, the change was well-nigh complete. Those who walked down the avenue of giant generators of the machine gallery can never forget the impression of size which those machines produced. Two rows of huge slow-speed direct-driven alternators of the pattern with revolving magnet wheel, and stationary external armature, seemed to establish a definitive type. The total disappearance of the bipolar dynamo, the almost complete disappearance of the revolving armature type, and the prevalance of the three-phase construction, all characterised a distinct development. It appeared to demonstrate that though progress had advanced by different lines in different nations, the consensus of all engineering experience had at last concentrated on a final type.

Yet all the while a new development had been in progress which, though not much in evidence at the Paris Exhibition, had nevertheless been spreading quietly in England. The steam turbine had dawned upon the horizon, and had, indeed, for over ten years, been in active evolution. Steam engineering had indeed been necessarily progressing toward higher speeds, even with reciprocating engines. For thermodynamic efficiency implied working between wider temperature limits, and as the lower temperature could not be reduced below that of the water of the condenser, the necessary course was to increase boiler pressures and superheat the steam. Higher superheat involved new difficulties respecting lubrication and the expansions of the working parts. It necessitated higher piston velocities. To get higher piston velocities resort must be had to increased number of revolutions. And the high-speed reciprocating engine was found to offer advantages of its own, in economy of space, greater evenness of turning movement, and convenience of enclosure of the moving parts. But even so the high-speed reciprocating engine soon began to find a formidable rival in the steam turbine, which with its huge peripheral velocities, its simplicity of lubrication, economy of space, and absence of vibra-

tion offered certain advantages over any reciprocating engine, however good.

Other influences, too, were at work in the same direction. The introduction of motor-generator sets in sub-stations, for conversion from high-voltage alternating to low-voltage continuous currents, gave another cause for the adoption of high speeds, and, as we shall see, independently led to new types of high-speed generator.

Output of Electric Generators.

Various factors influence the output of electric power which can be obtained from an electric generator of given construction. Assuming always that there is adequate mechanical power available to drive it, and that the speed can be adjusted to the most favourable value, the normal output is limited in several different directions. There are, as everyone knows, two factors in electrical power —current and voltage. If the voltage is fixed, the output is proportional to the current. We may consider separately the limitations of these two factors.

The current that can be drawn from the machine at the working voltage is limited (*a*) by the heating of the armature or other part of the machine; (*b*) by the reaction of the armature interfering with the voltage of the machine; (*c*) in the case of continuous current generators by the difficulty of sparkless collection of the current. On the other hand, the voltage of the machine is limited by other considerations; (*d*) the speed at which the armature is driven; (*e*) the magnetism provided by the field-magnets; (*f*) the adequacy of the insulation of the conductors. Beside these limitations which affect the two factors separately, there is a limitation due to them jointly, namely, (*g*) the adequacy of the mechanical construction of the armature, its mounting, and its shaft to withstand the application of the torque, when running at the actual speed. There are yet two other limitations to be considered, namely (*h*), the prescription of some particular efficiency, and (*i*) the capacity to endure a temporary overload of some prescribed amount for some prescribed duration. The former of these is practically bound up with the limitation of the temperature rise, since any machine which has a low efficiency is bound to evolve as heat the energy which it wastes; and the latter is more or less involved in the compliance with the requirements at normal load and in the provision of ample margins of safety.

The recommendations of the Engineering Standards Committee define the conditions that shall govern the rating of the normal output of generators for continuous, as distinguished from intermittent, employment as follows:— "The output of generators (and motors) for continuous working shall be defined as the output at which they can work continuously for six hours and conform to the prescribed tests." No detailed regulations as to tests have yet been issued, pending further investigations as to the same limits of temperature rise that are permissible. If, following the general lines of the American and German rules for rating, we assume 50° C. as the maximum rise in continuous working, and an overload capacity of 25 per cent. for not more than two hours, we shall probably not be far from the ultimate rules to be laid down by the committee. The Standards Committee has also laid down for alternators the additional rules that their voltage curves shall, under all working conditions, be as near as possible a sine-curve, and that they shall not have a greater percentage pressure-rise (from full-load to no-load), with same speed and excitation, than 6 per cent. on a non-inductive load, nor more than 20 per cent. on an inductive load having a power-factor of 0·8.

Let it be then assumed that by rules such as these the proper rating of any generator can be arrived at, the questions immediately before us are in what relation does the normal performance of a machine, that is its rated output, stand to the design of the machine and ultimately to its cost, and in what way are these affected by the engine-speed.

Manufacturers are naturally desirous of producing as cheaply as possible the machines that are to fulfil the required specification. The prime cost of materials, iron, steel, copper and mica or other insulating material, and the cost of labour affect the design to be adopted. For of two designs for the same specification, one may require more material the other demand more labour; and it is quite conceivable that one design might be right for a manufacturer in a country where labour is dear and material cheap, and a different design to be better in another country where labour is cheap and material dear. This is not the point really before us. We have to consider how the change from low speeds to high speeds affects the design, for whatever changes that development favours, the tendency will operate irrespective of the particular economics of the place of manufacture.

Let us consider the fundamental formulæ which state the dependence of the electromotive force of a generator upon the speed, the number of armature conductors, and the flux per pole. We write the following symbols :—

E = electromotive force, in volts or virtual volts,

n = revolutions per second = R.P.M. ÷ 60,

Z = number of conductors all round the armature,

p = number of poles,

c = number of circuits through the machine,

N = flux from one pole.

Then we have as the general equation :—

$$E = \frac{p}{c} \times n \times Z \times N \div 10^8, \ldots\ldots (1)$$

For alternating electromotive-forces the expression needs to be multiplied by the factor 1·11. Here p and c are mere numerics, while the numeric 10^8 is occasioned by one volt being one hundred million lines per second. Now, let us write C_1 for the normal amount in any one circuit, and C for the whole current furnished by the machine. Clearly $C = C_1 \times c$. Multiply both sides of equation (1) by this quantity and we get an expression for the normal output in watts, which we may arrange as follows :—

$$EC = n \times C_1Z \times pN \div 10^8 \ldots\ldots (2)$$

The quantity C_1Z is the whole loading of current upon the periphery of the armature, irrespective of the direction of the current. If the current density in the copper is assumed constant, the loading is proportional to the whole cross section of copper in the transverse section of the machine. The quantity pN is the magnetic loading, or, in other words, the whole number of magnetic lines that crosses the air-gap from all the poles, irrespective of the direction of the flux across the gap. It is proportional if the flux-density in the gap is assumed at a constant mean value, to the total pole-face area around the machine, or, roughly, is proportional to the quantity of iron in the machine. Hence we see that our formula gives us the information that the output is proportional to engine-speed, to total cross-section of copper, and to total pole-area of iron. Further, be it remarked that in ordinary continuous current generators for electric lighting while n, the revolutions per second, is a quantity of the order of from 2 to 12; the quantity C_1Z is of the order of 1,000 to 100,000; while the quantity pN is of the order of magnitude from 1,000,000 to 100,000,000. If we are considering the causes of limitation to output we are at once met with the engine-problem as limiting n, while as to the two other quantities which represent the integral electrical loading and the integral magnetic loading of the armature, it is found from experience, at least so far as continuous-current machines go, that satisfactory performance cannot be obtained* unless the latter is about 1,000 times as great, numerically, as the former. There is another limitation in the above formula, namely, a limitation to the product np, for $\frac{1}{2}np$ is the frequency of magnetization of the armature iron as it passes the poles. This is of course a prescribed quantity in the case of alternators, being usually 50 for lighting machines or 25 for power generators; so that np must be either 100 or else 50. In the case of continuous-current machines, designers usually keep down either n or p, so that the product np shall not be more than 40 (often under 40) so as to keep down the energy losses in the iron of the core and teeth.

Now different designers have different ways of looking at the output of machines and of proceeding in working out new designs. Design is an art quite as much as a science, and in the case of experienced designers it makes little difference with what datum they begin : they will, as by a sort of instinct, work round to the final form. One method that is certainly used by some designers is to think of each pole as providing or corresponding to a definite portion of the output, and therefore regarded as a sort of "unit," from which to proceed. Thus, naturally, a tramway generator with 10 poles will be a machine of bigger output than one with 6 poles. If design were to be put on this basis it would be needful to assign a definite number of kilowatts per pole. But this is by no means a safe guide. For leaving out all machines under 20 kilowatts, the number of kilowatts per pole run from about 8 in small continuous current generators up to 70 in large ones ; and in ordinary alternators, run from about 10 in single-phase machines up to

* The argument is as follows :—Let the pole pitch be denominated τ, the pole span b, the length from point to back of the pole-face l, the ratio of b to τ be called ψ, the specific loading of the amature (ampere-conductors per inch peripheral) q, and the flux-density (mean) at the pole-face B ; then :—

$$\frac{pN}{C_1Z} = \frac{Bbl}{q\tau} = \frac{Bl\psi}{q}$$

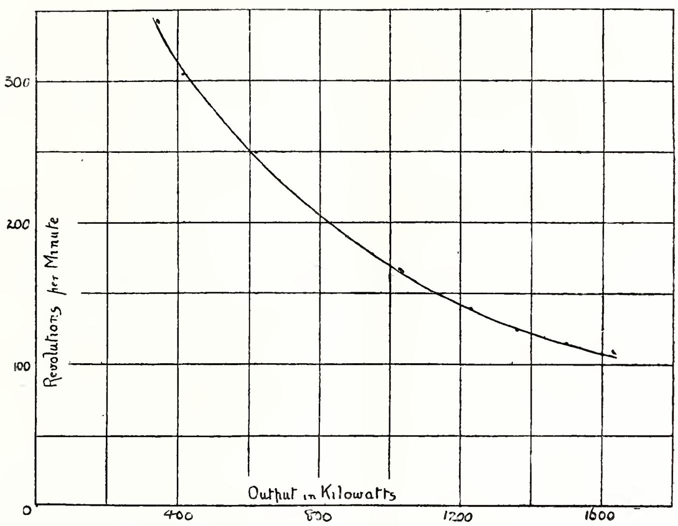
Now the value of ψ is about 0·75, while the machine will not be satisfactory as to heating, distortions, and commutation unless q is not greater than 660, and l than 16, nor unless B is about 55,000 (all these in inch units). Hence the above ratio is about 1,000.

50 or 60 in large three-phase machines, while in the Niagara generators the figure runs up to 313 in one case and to 625 in another. In the large alternators at the Paris Exhibition the mean value was 22·1, but the figures varied from 4·4 to 125. Clearly we cannot take the number of kilowatts per pole as a guide, save for some very narrow range of machines, and even then practice shows that the machines of experienced firms do not conform to any such rule.

The late Mr. Sidney Short, in a paper which he read to the Manchester Section of the Institution of Electrical Engineers,* once proposed such a method of designing continuous-current tramway generators. The poles of all machines were to be of the same size, that parts might be interchangeable, the output being in all cases 68·5 kilowatts per pole. The pole-pitch was to be 25 inches, the core length from front to back about 8 inches, the slot-pitch 1 inch, the flux per pole was to be 10·3 megalines, and the peripheral velocity for all machines 3,300 feet per minute. According to this plan a 4-pole machine of 273 kilowatts would have run at 396 R.P.M., and a 16-pole machine of 1,092 kilowatts at 99 R.P.M., the speed being inversely as the output.

Now, unfortunately for any such proposition for simplifying the design of a standard line of machines, this is not what the engine-builders will agree to. In a standard line of reciprocating engines the speed does *not* go down in inverse proportion to the rated output. It is true that the bigger the engine the slower is its speed, but the output is more nearly inversely proportional to the square of the number of revolutions per minute, or to some inverse power between the first and second powers.

FIG. 2.



RELATION BETWEEN OUTPUT AND ENGINE-SPEED OF SIEMENS AND HALSKE TRAMWAY GENERATORS, (1902).

The following is from a recent line of tramway generators of the firm of Siemens and Halske:—

KW.	R.P.M.	(KW. × R.P.M.) ÷ 10^3	(KW. × R.P.M.^{2}) ÷ 10^5	(KW. × R.P.M.$^{3/2}$) ÷ 10^4
350	340	119	405	229
415	305	127	386	222
500	280	140	392	234
620	250	154	385	243
750	225	169	380	253
830	200	166	332	233
910	180	164	295	220
1075	160	172	275	218
1230	140	173	242	205
1360	125	170	212	190
1500	115	172·5	198	189
1630	105	172	181	176
1700	100	170	170	170

The data are plotted graphically in Fig. 2.

* The *Electrician*, April 5, 1901, vol. xlvi., p. 205.

If we consider the figures in the last three columns it will be seen that the output appears to vary inversely as about the 1·6 power of the speed; or

$$KW = \frac{250{,}000}{(R.P.M.)^{1 \cdot 6}}$$

The upshot of all this is that if combined sets are to be constructed as economically as possible the dynamo-builder must not force arbitrary conditions upon the engine-builder that are unsuitable for the construction of standard lines, but must be content to design his dynamos to meet the conditions found otherwise to be best for steam-driving.

There is another mode of regarding the design of electric generators which is originally due to Mr. H. A. Mavor,* and which employs the conception of the "active belt." If we regard any modern generator, whether for continuous or alternating currents, we observe that there is a large portion of the machine which is motionless and another large portion which, though moving, is merely moving, and is electro-magnetically inert. The whole of the electromagnetic actions occur in a very narrow belt of the armature, namely, in that annular portion of space where the copper conductors are cutting across the magnetic lines. It is here where the real action of the machine takes place. It is here where the mechanical energy transmitted through shaft, hub, and core, is transformed into electric energy. It is here where the conductors that carry current must be propelled across the magnetic field to cut the magnetic lines. It is here where the mechanical forces are found, against the reaction of which the mechanical forces, transmitted from the prime mover, must be exerted. It is therefore a peripheral belt of the armature extending in width through the core from front to back, and in depth to the bottom of the slots. If the diameter of the armature at the face be d, the core-length from front to back l, and the depth of the slots s, then the volume of this *active belt* will be $\pi\ (d \pm s) \times l \times s$; the + sign applying to the case of stationary external armatures, the − sign to rotating internal armatures. In large machines where s is small compared with d, the volume is approximately equal to πdls. Of this volume, part is occupied by iron teeth through which the magnetic fluxes traverse the belt radially; part consists of copper through which the electric currents flow parallel to the shaft; and part consists of inert insulation, some of which surrounds the copper, and some lies between the laminations of iron. If we consider the annular flanking surface of this belt, of area approximately πds, there passes through this area the whole current loading which we have called $C_1 Z$. If we divide this by the area we shall obtain an expression for the mean gross current density through the active belt, which we may write :—

$$\alpha = C_1 Z \div \pi ds.$$

If next we consider the principal surface πdl of the belt, and remember that through this there enters the integral magnetic loading pN, we can similarly find mean gross magnetic density in the active belt as :—

$$\beta' = pN \div \pi d$$

Now, returning to our equation (2), page 994, let us substitute for the three factors on the right hand their respective values,

$$n = v \div \pi d,$$

where v is the peripheral speed in inches per second

$$C_1 Z = \alpha\, \pi ds$$
$$pN = \beta' \pi dl$$

and we obtain at once

$$EC = \frac{v}{\pi d} \times \alpha \pi ds \times \beta' \pi dl \times 10^8$$

whence, dividing down by πdls, we get as the number of *watts per cubic inch of active belt* the value :—

$$\frac{EC}{\pi dls} = v \times \alpha \times \beta' \div 10^8.$$

In other words, the specific utilisation of the materials of the active belt depends on three factors only (apart from the numeric 10^8), namely, the *peripheral speed*, the *gross electric density* and the *gross magnetic density*. We may call these the *three factors of specific utilisation of materials*.

Now, as it is clearly to the interest of the manufacturer to use as little material as possible for getting the prescribed output, it is clear that he ought to aim at having as few cubic inches as possible per kilowatt of output, or getting as many watts of output as possible per cubic inch of active material.

In the course of the last few years I have examined the data of a very large number of machines to ascertain the value of their constants, and in particular of these factors of utilization. In the case of continuous-current machines the values of v lie mostly between 400 and 900 inches per second (*i.e.* between 2,000 and 4,500 feet per minute); those of α, between 300 and 460 amperes per square inch

* "Journal Institute of Electrical Engineers," xxxi., p. 218, 1901.

gross; those of β', between 30,000 and 45,000 lines per square inch gross. The watts per cubic inch of active belt run from about 45 to 120. A few machines go outside these figures. Some particular cases are cited in my work on Dynamo-Electric Machinery. In old and inferior machines, and also in special machines for high voltages, where insulation necessarily takes up a greater fraction of the space otherwise available for active materials, the figures are low.

In the case of alternators of ordinary pattern, the values run somewhat differently. The difficulty of constructing machines with revolving armatures with a sufficiently high peripheral speed to give a wide enough pole-pitch, together with the greater ease of insulating stationary structures, has led to the preference for the type with rotating magnet-wheel. And, with the adoption of edge-wise strip winding on the poles, higher peripheral speeds have been possible, so that the usual values of $\dot{v}$ run from 1,000 to 1,400 inches per second (*i.e.* 5,000 to 7,000 feet per minute). But owing to the necessity of avoiding too great armature reaction, $\acute{a}$ seldom reaches 400, and is more usually between 220 and 300 amperes per square inch gross; while the value of β' cannot well be pushed beyond 30,000, and in 50-cycle machines is seldom carried beyond 24,000 or 25,000 lines per square inch gross.

In reflecting on these figures it must be borne in mind that these are not the nett densities. Suppose that in any machine the teeth and slots are of equal breadth, and that of the total area of slot one-half is taken up by insulation and packing, then though the true current density in the copper may be 2,000 amperes per square inch of section, this will be only 500 amperes per square inch gross: and if in the iron the true flux-density is 100,000 lines per square inch, yet if the pole covers only 0·7 of the pole pitch, and if the slots take up equal width with teeth, and if 15 per cent. of the total armature core-length is taken up by ventilating ducts and insulation, then the factor β' will be only 30,000 lines per square inch gross.

It is therefore obviously important to use such dispositions that the space-factor of the copper in the slot can be as high as possible consistently with adequate insulation. Round copper wires are to be avoided. They take up just as much useful space as square wires and have only 0·7854 conductance. The substitution of square—or rectangular—wires for round wire is equivalent to the discovery of a new metal having a conductivity of 127 per cent. as compared with copper. Let us write σ_1 for the copper space-factor in the slots and σ_2 for the iron space-factor in the teeth, ζ for the ratio of slot-breadth to slot-pitch, and $1\text{-}\zeta$ for the ratio of tooth-breadth to tooth-pitch.

Then

$$\acute{a} = \alpha\zeta\sigma_1,$$

and

$$\beta' = B_t\psi\,(1\text{-}\zeta))\,\sigma_2,$$

where B_t is the mean flux-density in the teeth, so that the equation of utilisation becomes

$$\frac{EC}{\pi dls} = \dot{v} \times \alpha\zeta\sigma_2 \times B_t\psi\,(1\text{-}\zeta)\,\sigma_2 \div 10^8 \;\ldots.(4)$$

in which form appear the real current density and the real flux-density on which mainly depend the armature losses and the heating. Now the product of ζ into $(1\text{-}\zeta)$ will be a maximum if $\zeta = 0{\cdot}5$, that is to say, other things being equal, the specific utilisation will be highest if tooth and slot are each of equal breadth, a condition mostly reached in tramway generators. The copper space-factor σ_1 usually lies between 0·4 and 0·6 in large tramway generators. It may reach 0·7 or even 0·75 in low-voltage machines. In alternators at 2,000 to 3,000 volts it varies between 0·25 and 0·35. In those at 1,000 volts it varies between 0·06 and 0·2. The iron space-factor σ_2 depends partly on insulation and partly on the space taken up by air-ducts. If the laminations are 20 mils thick, insulated with a thin paper sheet, and if there are no aid-ducts, σ_2 may be as high as 0·92 or 0·93; but good ventilation necessitates air-ducts, and in modern machines the air-ducts may take up from 15 to 20 per cent. of the available iron-section, making σ_2 from 0·74 to 0·80.

We are here face to face with the possibilities of making the highest use of our materials. Peripheral speed costs nothing, *per se*; but it involves the strength of materials, and a design that affords adequate strength in the mechanical parts. With the adoption of toothed cores, which I have advocated consistently from the date of my Cantor Lectures here in 1883, the use of higher peripheral speeds has been made possible. The core bodies being built up of laminated steel, are also now safely driven at speeds impossible formerly. It is probable that the future will see a further development in this direction. The change in design in continuous-current generators from the early bipolar and multipolar types to those of more recent date (as exemplified particularly in the Berlin stations) illustrates this attainment of higher specific utilisation by higher peripheral speeds, and a type of armature

more nearly approaching a fly-wheel in design.

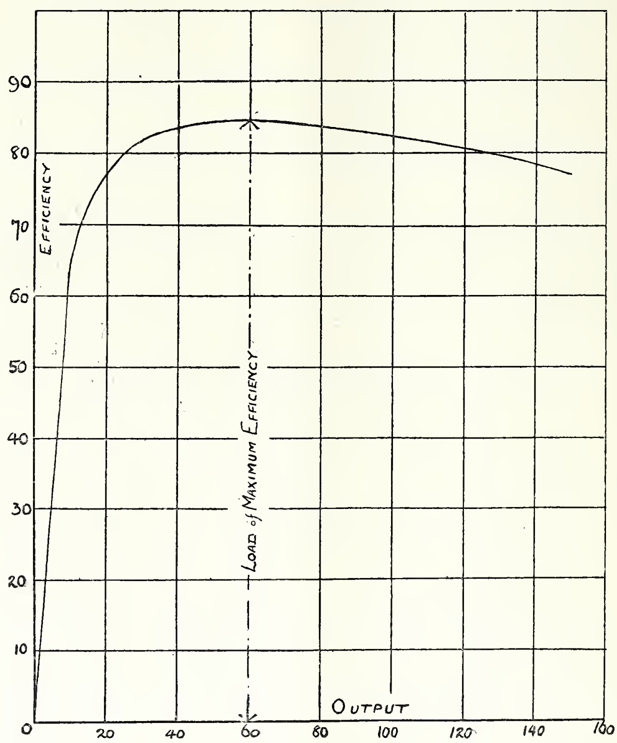
In examining equation (4) we see that specific utilisation is augmented by using high densities of magnetism in the teeth. This of course involves heating since the hysteresis losses go in proportion to $B^{1\cdot 6}$ and the eddy-curved losses in proportion to B^2. On the other hand the specific utilisation is augmented by using high current densities in the copper, and the losses are proportional to α^2. In either case the attempt to exact the utmost specific utilisation of material involves a lowering of the running efficiency; while the attempt to attain the utmost efficiency implies the adoption of a low specific utilisation. But it must not be forgotten that the losses due to iron (which we may take as approximately proportional to B^2) are practically constant at all loads, while the losses due to copper resistance (which are approximately proportional to α^2, as the resistance rises only slightly with temperature rise) are distinctly load-losses.

This brings us to the question of efficiency, the ratio of output to input. If we write η for the efficiency, x for the load kilowatts, a for the no-load losses which are practically constant or rise only very slightly with the load, then the equation of efficiency is:—

$$\eta = \frac{x}{a + bx + cx^2}$$

where b is a quantity that is of the order of $1\cdot 02$. The coefficient c depends chiefly on the copper resistance, and is nearly constant. The curve of efficiency plotted from this equation shows the following features. For $x = o$, $\eta = o$. For small values of x, such that x and cx^2 are both small compared with a, the equation is $\eta = x/a$, which gives the asymptote to the first part of the curve. Then it takes the approximate value $\eta = \dfrac{x}{a + x}$. When the load is such that $cx^2 = a$, or $x = \sqrt{a \div c}$, η becomes a maximum. Finally if x is great relatively to a, the equation becomes approximately $\eta = 1 \div (1 + cx)$.

FIG. 3.



CURVE OF EFFICIENCY AT DIFFERENT OUTPUTS.

It is generally recognised by engineers that the efficiency is a maximum at that point when the load-losses and no-load losses are equal. The adoption of high current-densities in the copper for machines that are for but a small

part of their working hours working at their rated maximum load is here justified.

All the foregoing considerations have been directed to the utilisation of materials in the active belt. But this is only a portion of the whole materials of the machine. Indeed, the total weight of the generator is from 12 to 25 times the weight of the material in the active belt. Mr. Mavor has kindly supplied me with some data of his continuous-current generators, from which it appears that the iron in the belt is from 23 to 32 per cent. of the armature iron (in many machines it is smaller) while the copper in the belt is from 33 to 43 per cent. of the armature copper. In large alternators the armature copper is from $\frac{1}{3}$ to $\frac{1}{6}$ that of the copper on the field-magnets, the most usual proportion being $\frac{1}{4}$. But as the "active" copper is usually only some 40 per cent. of the whole armature, it follows that the inactive copper on such machines is some eight or ten times as great as the active copper. Clearly, then, it does not do to push the sole consideration of the active belt too far; nor to forget that many of the points as to increased specific utilisation are equally applicable to the inactive parts, for example, the remarks about copper space-factor and the advantage of using square wire instead of round, apply equally to the winding of field-magnets.

One broad fact stands out above all these considerations—the advantage gained by the adoption of a *high peripheral speed*; and this is the important consideration in the present regard.

Passing on to the question of design it may be remarked that the last years have seen a very important development in the processes of designing, in the discovery and use of certain rational formulæ which, while based on first principles, and therefore true for all classes of machines by all different makers, contain certain factors or coefficients, the values of which are determined by experience. The first suggestion for such rational formulæ came in 1891* from W. B. Esson. They have gone through various stages of evolution, but resolve themselves into expressions in which the rated output is given in terms of the dimensions of the armature core or *vice versa*. If d be the diameter of the armature at the face, and l the length of the core parallel to the axis (both in inches), then the formulæ for output may be expressed either in terms of d^2 and l (that is proportional to the volume of the core) or in terms of d and l (that is proportional to the peripheral surface of the core. The former plan (due to Esson) involves the revolutions per minute. The latter (due to Steinmetz) does not, since it assumes an appropriate peripheral velocity. In applying the expressions to alternators the apparent kilowatts (that is, the kilovoltamperes) must be taken, not the nett output, since the copper parts must be large enough to carry the actual amperes, whether in phase with the volts or not.

In their final forms these output equations are as follows :—

$$d^2 l = \xi \times \frac{\text{KW.}}{\text{R.P.M.}}$$

$$dl = \beta \times \text{KW.}$$

Where the output co-efficients ξ and β have the following values :—

Continuous Current Generators.

$$\text{(Esson)} \qquad \xi = \frac{60{\cdot}8 \times 10^{10}}{B_g \times q \times \psi};$$

$$\text{(Steinmetz)} \quad \beta = \frac{15{\cdot}9 \times 10^{10}}{B_g \times q \times \psi \times v}.$$

In these formulæ B_g stands for the density of the flux in the gap, considered as uniform over the ideal pole surface; q the specific electric loading, or number of amperes carried per linear inch of the periphery; ψ the ratio of the equivalent pole-span to the pole-pitch; v the peripheral speed in feet per minute.

The co-efficients ξ and β are connected by the relation :—

$$\beta = \xi \times \frac{1}{d \times \text{R.P.M.}} = \xi \times \frac{\pi}{12v}.$$

Alternate Current Generators.

$$\text{(Esson)} \qquad \xi = \frac{60{\cdot}8 \times 10^{10}}{\kappa \times B_g \times q \times \psi};$$

$$\text{(Steinmetz)} \quad \beta = \frac{15{\cdot}9 \times 10^{10}}{\kappa \times B_g \times q \times \psi};$$

Where κ is a co-efficient worth about 1·11, depending on the form-factor of the magnetic distribution, and on the distribution or concentration of the armature windings in slots.

The pole-pitch τ of alternators depends only on the peripheral speed v, and on the frequency f. If v is expressed in feet per minute, and f in cycles per second, then the value of τ in inches is given by the formula :—

$$\tau = \frac{v}{10f}.$$

This relation has the result that if the foundation wheel of the revolving field-magnet structure is of cast iron, since the appropriate safe peripheral speed for the magnet-poles is about 5,000 feet per minute, the pole-pitch

* Journal Inst. Electr. Engineers, xx., p. 272, April, 1891.

will be about 10 inches for alternators of the normal frequency of 50 cycles per second, or 20 inches for the less usual frequency of 25 cycles per second. For field-magnet systems built of steel laminations or of solid compressed steel, higher peripheral speeds are safe, and the pole-pitch becomes correspondingly greater.

Another rational formula of great value in determining the size of frames, since it fixes the total flux from all the poles, is given by the expression—

$$p\mathrm{N} = \frac{\mathrm{K.V.A.}}{v \times q} \times 445{,}000 \times 10^6$$

where p is the number of poles, N the flux from any one pole, K.V.A. the output in kilo-voltamperes, and v and q have the same meanings as above.

The formulæ given above are all *rational.* Those for continuous-current generators can be easily deduced from the following four expressions:—

1. Electromotive force generated.

$$\mathrm{E} = \frac{p}{c} \times \frac{\mathrm{R.P.M.}}{60} \times \mathrm{Z} \times \mathrm{N} \div 10^8;$$

where c is the number of circuits in parallel through the armature, and Z the number of armature conductors (total), in the slots.

2. Number of armature conductors.

$$\mathrm{Z} = q \times \pi \times d \times c \div \mathrm{C};$$

where C is the whole current at full load. This formulæ is a consequence from the definition of the specific electric loading, q, as the number of amperes per inch of the periphery; for each conductor carries $\mathrm{C} \div c$ amperes, and the periphery is $\pi \times d$, whence $q = \mathrm{ZC} \div \pi dc$.

3. Flux per pole.

$$\mathrm{N} = \mathrm{B_g} \times d \times \pi \times \psi \times l \div p;$$

for the pole face area is equal to the pole-span $d\pi\psi \div p$ multiplied by l, and multiplying this by the mean flux-density over the area gives the flux.

4. Output in kilowatts.

$$\mathrm{KW} = \mathrm{E} \times \mathrm{C} \div 1000.$$

An example of the use of such formulæ may be given by way of illustration. Let it be required to find the principal dimensions d and l for a continuous-current generator to give 160 amperes at 250 volts, to run at 300 R.P.M. This will be a 400 kw. machine. Experience shows that for such a machine appropriate values of the constants will be: $\mathrm{B_g} = 55{,}000$; $q = 600$; $\psi = 0{\cdot}75$; $v = 3{,}600$; Hence the Esson co-efficient will be

$$\xi = \frac{60{\cdot}8 \times 10^{10}}{55{,}000 \times 600 \times 0{\cdot}75} = 24{,}600$$

$$d^2l = 24{,}600 \times \frac{400}{300} = 32{,}800$$

$$\text{Now } d = \frac{12 \times v}{\pi \times \mathrm{R.P.M.}} = \frac{12 \times 3{,}600}{\pi \times 300} = 45{\cdot}7 \text{ ins.}$$

$$\text{So } l = \frac{32{,}800}{45{\cdot}7 \times 45{\cdot}7} = 15{\cdot}7 \text{ ins.}$$

Now the advantage of rational formulæ such as these is this:—That, taking as a basis of experience a few machines which have been found to work well, and deducing from their dimensions and performance the values of the constants $\mathrm{B_g}$, q, ψ, and v, those same constants can be used to design other machines of different outputs and speeds, with the absolute certainty that when constructed their performance will be such as to fulfil the prescribed specification. The output formulæ give a direct means of starting with the proper dimensions. They do not, it is true, afford an immediate solution to the question of the cheapest machine, for whether we use the d^2l or the dl formula, choice is still left as to the particular values of d and l which will meet the case. That is to say the formula furnishes the designer with a number of *primâ facie* designs each of which will fulfil the specification, and amongst these he must subsequently select the one which under the existing conditions of cost of materials and labour and of the organisation of his factory will be the cheapest to construct. On the question of design in relation to manufacturing costs, several most valuable papers have been published by Mr. Hobart,* whose experience as a designer has been probably as extensive as that of any other engineer. One may use either the d^2l formula or the dl formula as a basis, but I am disposed to the view that while the former is more suitable for designing continuous-current generators, the latter is preferable for alternators. For in the case of continuous-current designs, the dominant question is sparkless commutation, not heating, nor regulation, and surface speed is a secondary consideration; whereas in ordinary alternators smallness of voltage drop is the dominant question, and the surface speed is vastly important as it governs the pole-pitch. We shall return to these questions in the second and third lecture.

It remains to give a few examples to con-

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* "Electric Motors," Whittaker and Co, 1905. "Elec. Mag.," August 1905. "Method of Designing Induction Motors," St. Louis Congress, 1904. "Jour. Inst. Elec. Engs." xxxvi., p. 374.

trast the designs which are respectively appropriate to high and low speeds. For the present occasion I select examples that are not the product of steam-turbine practice, but have arisen independently.

First, I contrast the designs of two continuous current machines by the same firm, Messrs. Dick, Kerr, and Co., of equal output, namely, 280 kilowatts, both being tramway generators at 550 volts.

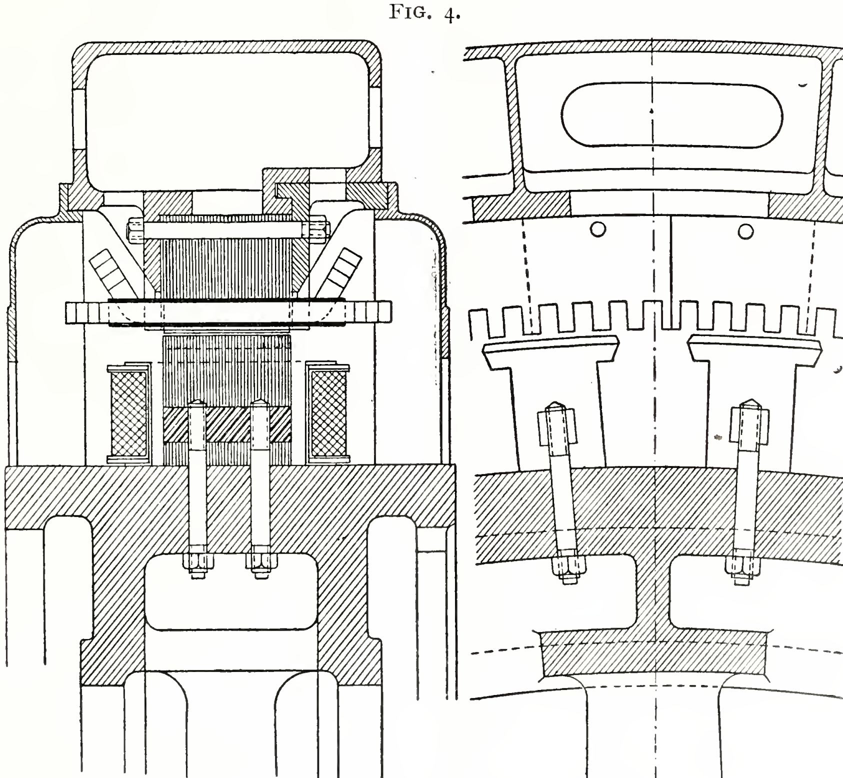
	Low Speed. MP 10—280—90.		High Speed. MP 6—280—400.
Diam. .... d	90 in.	..	40 in.
Core length l	17 in.	..	14 in.
v	2,120	..	4,190
ξ	44,400	..	32,000
β	5·45	..	2·00
Weight	89,230 lbs.	..	27,400 lbs.

It is apparent on consideration of these figures that the Steinmetz coefficient, β, affords a more ready indication of the size of a machine for its output than does the Esson coefficient ζ.

The next example that I take is a contrast between two alternators both constructed by one firm, the Oerlikon Maschinen Fabrik, and both of about the same output, one being 290 the other 270 kilvoltamperes. One runs at 125 R.P.M., the other at 600 R.P.M. Both are for frequency of 50 ~, one being 48 poles, the other 10.

	Low Speed. ATB 48-276-125.		High Speed. ATB 10-290-600.
d	157·7	..	35·5
l	6·7	..	15·8
Slots............	288	..	60
δ	0·2	..	0·1
τ	10·3	..	11·15
b	6·5	..	7·1
Bg	43,600	..	48,700
q	307	..	452
ψ	0·63	..	0·62
v	5,150	..	5,570
ξ	77,000	..	41,200
β	3·92	..	1·94
a	1,750	..	2,120
a_m	272	..	405
σ_1	0·24	..	0·25
Slots..........	288	..	60
Cub. inch of iron (core and teeth)	15,940	..	10,090
Watts per cub. inch action belt	52	..	81
a'	193	..	286
β'	29,500	..	27,400
Overall diameter	232 in. 19′ 4″	..	53·6 in. 4′ 5½″

FIG. 4.



AT(B) 48 – 270 – 125; 5000 V. – 50~.

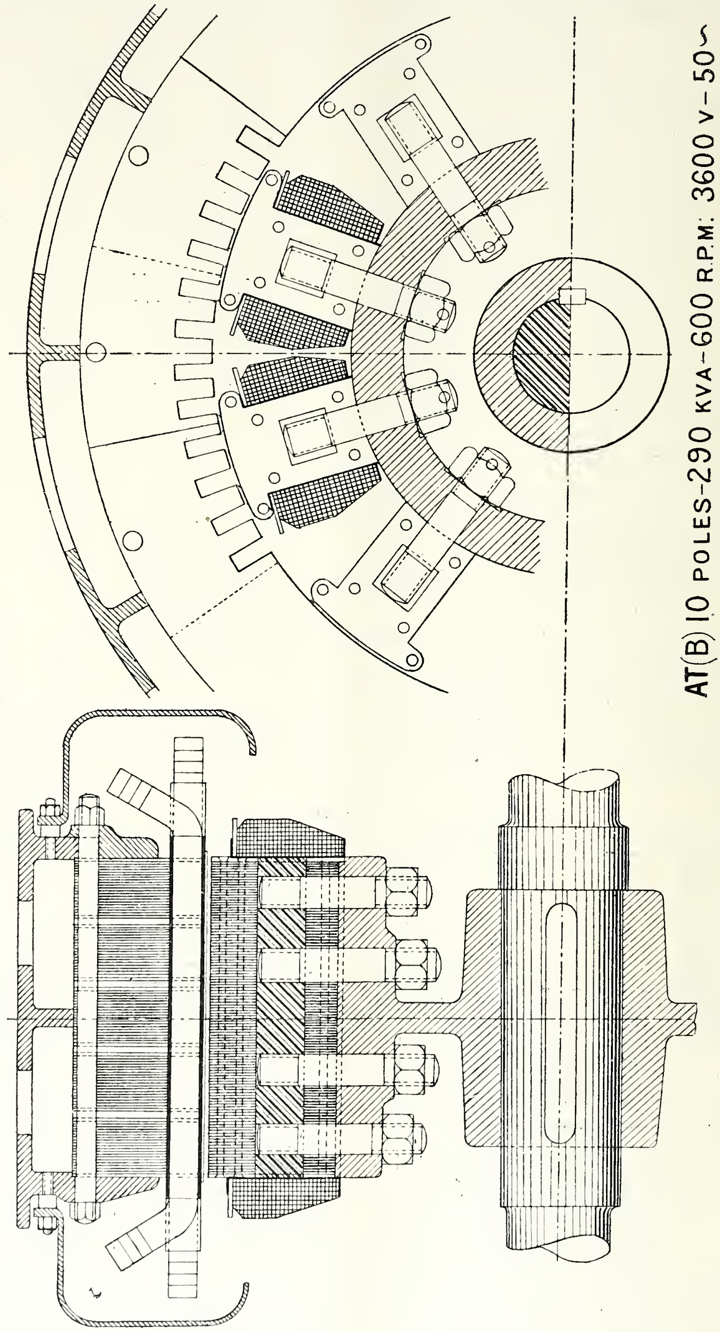


Fig. 5.

Figs. 4 and 5* give sketches of these two machines.

As a final example I select two motor generators of different firms and different outputs. One is by Messrs. Kolben and Co. as supplied to substations at Staleybridge, the generator part being of 6 poles, 200 kilowatts, at 400 R.P.M. The other is by the Oerlikon Company, the generator part being of 4 poles, 342 kilowatts, at 1,000 R.P.M., and is of specially compact design in order that it might be placed upon a locomotive.

* Reproduced from my work on "Dynamo-Electric Machinery," vol. ii., by kind permission of Messrs. E. and F. N. Spon, Ltd.

	Low Speed. MP 6-200-400.	High Speed. MP 4-342-1,000.
d	33·9	27·6
l	15·	11·8
δ	0·157	0·394
B	68,000	81,000
q	520	790
ψ	0·75	0·73
v	3,550	7,230
ξ	34,500	26,200
β	2·45	0·95
τ	17·75	21·6
α	1,390	1,920
Watts per cubic inch	88·2	213
$\acute{\alpha}$	366	502
β'	51,000	59,000
η	—	—
Slot depth	1·42	1·575
σ	0·33	0·53

The direct and indirect advantages of high peripheral velocity are here very manifest, as the excellent ventilation permits of the specific loading being increased to 790. But this machine had a cross-compensating winding, otherwise commutation would not have been sparkless. The Steinmetz coefficient β actually falls below unity in the high-speed machine.

RADIATION FROM GAS MANTLES.*

The ordinary explanation of the great luminous efficiency of the gas-mantle is that rare earths have a property of selective radiation, in virtue of which they send out a larger proportion of their radiant energy in the form of light than ordinary hot bodies.

Other explanations are that there is catalytic action going on; that cerium has two oxides and oscillates between the two states, and this produces the effect.

Another explanation, first given, I believe, by Ram ("Incandescent Lamp," p. 196), is that the Bunsen flame is really very hot, and that the mantle is of such low emissivity that it gets rid of so little power that there is little difference of temperature between it and the flame, and it is therefore hot enough to give the light by pure temperature radiation, without any anomaly.

One reason why the simple temperature explanation has been questioned is that the temperature of the Bunsen is generally taken to be much lower than it is. It is generally measured by means of platinum wires or thermo couples. These can never rise to the real temperature of the flame, as they are radiating, and must therefore be taking in heat by conduction, in which case they must be cooler than their surroundings.

* Abstract of paper read before Section A (Physics) of the British Association at York, 1906, by Mr. J. Swinburne.

The simple temperature explanation fits the phenomena. If pure thoria has low emissivity it will rise to a temperature near that of the shell of flame bathing it. Having low emissivity it will then give out little light, but the light will have a large proportion of visible and refrangible rays. If a very little of a body with a high emissivity be added, radiation will increase, but the temperature of the mantle will fall, as there must be a steeper heat gradient to supply it. The total radiation is then increased, and though the proportion which is luminous will be diminished, the total light will be increased. Further addition of the emissive substance increases the total radiation, and reduces the temperature until the light given is less even than with pure thoria.

By selective radiation may be meant that a body at the temperature of a black body emits some rays, and omits others, or that it has the power of emitting more refrangible rays than a black body at the same temperature. If two black bodies are in a reflecting envelope, at the same temperature, each radiates to the other, and absorbs power from the other. The heat in each is in a state of degradation corresponding to the temperature, and in a state of equilibrium it must be radiated and absorbed by each without further degradation. Heat radiated from a black body into a closed space in equilibrium is thus not degraded. If a body only emits the portion of the rays of high frequency, though it may radiate less power or energy per second, that energy must surely be of a higher grade than that of the black body at the same temperature, because it can be degraded into radiation of lower frequency. If that is so, this sort of selective radiation violates the second law. Emitting more refrangible rays than the black body is worse still. It does not follow from this that a body cannot emit rays of high frequency balanced by another batch at low frequency, so that their degradation corresponds with the temperature. This form of selective emissivity has not yet been invented by the advocates of this theory.

The catalytic action theory is vague. Generally catalytic action merely accelerates a change from unstable to stable equilibrium. It is difficult to see how catalytic action can affect radiation. A suggestion may be made. The gases in the hot shell combine at a certain rate, and the flame radiates heat, and comes up to a certain temperature. If the mantle causes quick combination intimately among its own particles, it may be possible that the temperature there may be higher than in the flame itself, so that the mantle may really be hotter than the flame. I have not seen this idea put forward. It is not needed to explain the phenomena, and it would be curious that all the bodies capable of increasing the light of pure thoria should be coloured oxides.

It is sometimes urged that the particles of rare earths have a special way of vibrating in resonance with the particles of hot gas, and thus radiate light preferably. This, again, would mean elevating heat energy to a grade higher than that corresponding to

the temperature, without rejection of heat at a lower temperature; a violation of the second law.

The same reasoning holds against the theory that ceria oscillates between two states of oxidation. If it did it could not supply energy by such means, and therefore could not deliver energy supplied as heat at a grade higher than that corresponding to the temperature of the body.

MARRIAGES, BIRTHS AND DEATHS.

The quarterly return of marriages, births and deaths, covering the period to March in the case of marriages, and to June in that of births and deaths, will not reassure those who have been disturbed by previous figures as to the population of England and Wales. As compared with the average rate of the first quarters of the ten years 1896-1905, the marriage rate has fallen from 11·4 per 1,000 to 10·7, and the births registered in the second quarter of 1906 were the lowest on record, in the proportion of 27·5 annually per 1,000 of the population against an average rate of 29·1 in the preceding second quarters. On the other hand the death rate continues to fall. The deaths registered in England and Wales last quarter were in the proportion of 14·6 annually per 1,000 persons living as against 15·9 in the corresponding period of the ten preceding years. Examination of the mortality figures shows that, at any rate so far as the present year is concerned, the fall in the death-rate is not due to the lengthening of the average life of the old—of those over 60 years of age. Compared with the mean ratio in the ten preceding second quarters, the mortality of infants under one year of age showed a decrease of 14·3 per cent.; that of persons between one year and sixty years of age a decrease of 10.7 per cent., and that of persons aged sixty years and upwards an increase of 3·2 per cent. The gain has been largest in the saving of infant life but the loss here remains very high. Of the 125,387 deaths registered last quarter, 24,311 were those of infants under one year of age. Measured by the proportion of deaths under one year to registered births this infantile mortality was 102 per 1,000, the average in the ten preceding second quarters having been 119. In the great towns the average was higher than elsewhere, averaging 108 per 1,000 births, the highest being 139 in West Bromwich and in Birmingham, 140 in Liverpool, 142 in Norwich, 144 in Bradford, 146 in Bury, and no less than 165 in Burnley. Taking deaths from all epidemic diseases, and including all ages, the largest number, 2,915 is attributed to measles, whooping cough coming next with 2,616, then diarrhœa with 1,224, and diptheria with 1,156. There was only one death from small-pox.

If the figures relating to the great cities of the world are compared some noteworthy results are obtained. The birth rate per 1,000 of London was 27·0, or ·5 under the average of England and Wales. The highest birth rate was in Madras and Trieste, 31·2, the lowest in Brussels, 18·6. The London death rate was 14·8 per 1,000, or ·2 higher than the average of England and Wales, the highest was 78·9 in Bombay, the next highest 40·8 in Madras, and 32.2 in Calcutta. Excluding these Indian towns the highest was 31·2 in Trieste, and the lowest 13·6 in Antwerp. If the deaths under one year of age to 1,000 births are taken, the number for London is 99. The highest —a terrible per centage—is 223 in Breslau, and the lowest, 80 in Christiania. Fever, including cholera, accounted for 2,701 deaths in Calcutta, 8,778 in Bombay, and 1,143 in Madras. In Europe, deaths from fever were highest in St. Petersburgh, 344; and lowest in Stockholm, 2; London having 50. In London the largest number of deaths from epidemic disease was due to measles, 765; and it is noticeable that in no other great city of Europe did the number exceed 463 (in St. Petersburgh); but in New York it was a trifle higher, at 478. Next to St. Petersburgh comes Vienna with 317. The returns do not give the percentage per 1,000, but making allowance for larger population, it would be interesting to know why the number of deaths from measles in London is so high. In Stockholm, with a population of 324,488, it was only 7; and in Venice, Rome, Bucharest, Christiania, there were no deaths from this cause, at any rate none recorded. London stands highest again, absolutely, with whooping-cough, which accounted for 406 deaths; the next highest in Europe being Berlin with 99. In Paris there were only 65, and in Antwerp, 8. On the other hand, in diarrhœal diseases the London record is strikingly good. There were only 205 deaths from this cause, whereas, taking Europe only, in Moscow they numbered 2,881, in St. Petersburgh 1,467, in Berlin 673, and in Vienna 652. The deaths from diphtheria (145), were absolutely higher in London than in any Continental capital, except St. Petersburgh, where they numbered 237; but it is noticeable that in New York they were 527. If London, with a population of 4,721,217, is compared with New York, with a population of 4,512,860, the following results are shown:—

	London.	New York.
Measles	765	478
Scarlet fever	144	218
Diphtheria	145	527
Whooping-cough	406	65
Diarrhœal diseases	205	883
Deaths under 1 year	99	144

On the whole, London compares very favourably with the chief American city, measles and whooping-cough being the exceptions. The death rate of 78·9 in Bombay, includes 7,376 deaths from plague, and 1,606 from diarrhœal diseases. In Calcutta, there were 1,006 deaths from small-pox.

TRADE CONDITIONS IN MANCHURIA.

The anticipated diversion of a part of the business hitherto centering at Newchwang, to Vladivostok and Dalny, has, according to the American Consul at Newchwang, been even more marked than the most apprehensive ever contemplated. There was a decided depression in trade during April and May last, coupled with a number of suspensions and failures among the native bankers. The predictions of established Chinese business concerns that 1906 would not compare well with 1905, in Newchwang shipping and trade, are therefore proving to have been well founded.

There are a variety of reasons now being offered to show why 1906 is commercially unsatisfactory, most of these reasons, as a rule, being traceable to the late war, or to conditions growing therefrom that have been more or less misleading to the average trader, both native and foreign. With the steady demand for beans and bean products—the chief yield of Manchuria—in Japan, and the resulting advance in prices, it has been assumed that the farmers were in possession of more money than ever before, and that the millions of Russian roubles and Japanese war notes left by the armies during the late war, together with a "hungry market" resulting from the recent armed conflict having interrupted the supply of goods on order, would create an unprecedented demand for large stocks. These large stocks were therefore purchased, until all available warehouses were crowded.

With the opening of the port of Newchwang, for the season of 1906, after being ice-bound for three months, business was found to be sluggish, and it soon appeared that shipments made to the interior did not reach the consumer promptly. The passage of goods between the outposts of the Japanese and Russian zones of military occupation was unsatisfactory, and was accomplished only at a great risk from robbers, and great expense in cart hire. Therefore the temporary relief to a congested commercial condition at Newchwang was followed by an abnormal state of affairs in the interior. The Newchwang merchants complained that 3,500,000 taels—about £512,000—were practically withdrawn from the local markets by being tied up in goods advanced to the interior districts. Money grew tight, and Shanghai returned drafts for large amounts. The money tied up in the interior was, roughly estimated, the aggregate due elsewhere to meet unsettled accounts. Beans and bean products did not arrive in the usual way from the interior, and practically all that did reach the port were handled by Japanese interests. Therefore the export trade, generally speaking, was even more unsatisfactory early in the season than the import trade.

In addition to the above conditions, there was observed another disquieting trade symptom resulting from the efforts, as exerted through the Japanese military administration, to re-adjust local banking methods, which are based on an intricate exchange and bank-paper transfer system. This system has been disarranged during wars and uprisings since the Chino-Japanese war, or for a period of over ten years. The local native bankers claim, as the result of prevailing conditions, to have suffered heavy losses, variously estimated as being between £400,000 and £600,000. Such estimates, however, are not to be considered even approximately correct. A number of Chinese banks have either suspended or failed, notwithstanding that it is the policy of the native bankers to assist in tiding over the reverses of their fellow townsmen. In addition to this policy, the efforts of the Japanese military administration to prevent further bank failures by urging mutual co-operation, were deemed helpful and timely, though not entirely successful. While the market steadied and temporarily revived somewhat, the opinions of local merchants and of others indicated the presence of a complication of commercially abnormal conditions that will not be fully removed until transportation facilities throughout Manchuria are re-adjusted, and export and import duties are imposed, and paid, on terms of equality, throughout the vast territory that has been the theatre of threatened and actual warfare by Japan and Russia for a number of years.

In the matter of railway rates, both in Northern Manchuria under Russian management, and in Southern Manchuria under Japanese control, interested merchants allege discriminations that are highly inconsistent with the spirit of the law, as usually applied to common carriers. Merchants report the rates on the Russian line, north from Kuanchengtze to Harbin, as being excessive and manifestly calculated to discourage shipments from Southern Manchuria into the rich provinces of Northern Manchuria. These merchants also complain that the rates on the Japanese line from Dalny to Mukden and other points are less than from Newchwang to the same points. The rates on the Japanese line are, it is announced, to be reduced materially.

Still another unprecedented condition manifested throughout Manchuria may be termed the period of transition which marks the final departure from the ancient method of transporting goods inland by the Chinese two-wheeled cart of the style in use prior to the Christian era, and the re-adjustment necessary to accommodate modern railway traffic methods. Prior to the late war, the Russians did not have a satisfactory opportunity to demonstrate the practical usefulness of the Chinese Eastern Railway. Now, however, both Japan and Russia seem about to utilise their railway properties, as goods carriers, to the greatest possible extent in the commercial exploitation of the districts of Manchuria in which they have extensive interests. The carts will meet the trains at the trains at the large distributing centres, and the river junks will continue to transport goods to points not conveniently accessible by rail. Already there is some rivalry between railway and junk traffic, partially growing out of the necessity of lowering masts in passing the railway bridges recently built by the Japanese between Mukden and Hsinmintun.

HOME INDUSTRIES.

The Corn Crops.—A quarter of a century ago acknowledged agricultural authorities told the Royal Commission on Agriculture then sitting that it was impossible to grow wheat at a profit in England at under 40s. a quarter. If that were true, or remained true during recent years, wheat growing would indeed have been an unprofitable industry. Not since 1883 has wheat exceeded 40s. per quarter in value. Taking the average of the ten years ended 1903–4 the price was 27s. 2d. In 1904–5 it rose to 30s. 7d., but for 1905–6 it was only 28s. 9d. Probably, if the average went over 30s. there would be a considerable increase in the area under wheat. The change in the acreage under cultivation during the last thirty years will be seen from the following figures:—

	Wheat.	Barley.	Oats.
1876	2,995,957	2,533,109	2,798,430
1906	1,755,716	1,751,238	3,042,926

In 1904 the acreage under wheat fell to the lowest upon record, 1,375,284, but in 1905 it rose to 1,796,995, and although it has not quite maintained the rise this year, the figures are still a great improvement upon those of 1904. It is noticeable that whilst the shrinkage of the area under barley has also been very considerable, the cultivation of oats shows a substantial increase. If values are considered, it will be found that they correspond more or less roughly with the changes in cultivation. Taking the septennial average price per imperial bushel the following results are shown:—

	Wheat. s. d.	Barley. s. d.	Oats. s. d.
1876	6 $4\frac{1}{4}$	4 9	3 $2\frac{1}{2}$
1905	3 5	3 $0\frac{1}{2}$	2 $2\frac{1}{2}$

The fall in the price of oats, although considerable, was much less than in wheat, which was not very far short of 50 per cent. It is remarkable how the price of wheat varies in home markets. Taking, for example, Canterbury and Tiverton for the eleven months ended August 1 last, at the former market the average price was 31s. 11d. per quarter, at the latter 26s. 5d. The differences in price in other markets, though less marked, were substantial. It would be interesting to know if there was any corresponding, or any, difference in the price of bread.

The Hop Crop.—Hop picking is now well advanced, and earlier estimates of the crop are likely to be confirmed by results. The splendid weather of the last few weeks has filled the cones with cupulin, and the hops, hanging sparsely, have had the full benefit of the sun, and have been gathered in splendid condition. Experts say they have never seen better hops than those of the present season. Unfortunately, the yield will be much below the average. The aphis blight made its appearance at the end of May, and it is only in gardens where growers commenced washing their hops immediately upon the appearance of blight, and kept on washing them until the middle of August, that there has been anything like a good yield. But many growers were unable to bear the very heavy expense of the continual washings, and some gardens will only yield from 1 to 2 cwt. per acre. This state of things is found in all the hop-growing counties, and the experts agree that the 1906 crop will not exceed in weight that of 1904. The price must go up very considerably, but whether it will go anywhere near the figure that would in some cases compensate for the small yield must depend upon the reserves of the brewers and the imports from abroad. It has been expected that American imports would be exceptionally large, but the latest advices tend to modify this opinion. The American home demand is large, and American brewers have been buying largely. Then the Continental crops are anything but favourable. In Poperinghe and Alost, from which, in 1904, many thousands of pockets of hops came to this market, the 1906 crop is small and the quality poor. Taking Germany, Austria, France, and Belgium together, it is not expected that their crop will be more than three-fifths of that of last year, and it is not thought likely that the Continent will be able to spare more than 50,000 cwt. Given 125,000 cwt. from America—and this is about the quantity thought likely by Messrs. W. H. and H. Le May—the imports from abroad will total about 175,000 cwt. to supplement the English growth, estimated at about 280,000 cwt. This would give a total supply of 455,000 cwt. But the year's consumption cannot be less than 700,000 cwt., and the deficiency of 245,000 cwt. must practically all come from the stock at present held by the brewers, seeing that outside their holdings there is not 10,000 cwt. Under the circumstances probabilities point to the price of hops being very high in the coming months, but high prices will not do very much to recoup the growers, and they are many, whose gardens have only yielded 1 or 2 cwts. to the acre, and many gardens have this year been absolute failures. The immense crop of last year did not prevent the acreage under hops this year falling 2,245 acres, and it may well be that the decrease in acreage will be considerably larger next year. It is noteworthy that whilst thirty years ago the consumption of beer was less than it is now by over 10,000,000 barrels, there were then over 72,000 acres in hop cultivation in England, whereas this year there are only 46,722 acres. It is to be feared that the shrinkage will continue. If it does there will be much cause for regret, for the labour employed in a hop field is very much larger than in any other kind of agricultural work, and if the Continental and American grower can make hop cultivation profitable there would seem to be no sufficient reason why it could not be made to yield an adequate return in England.

The Soap Industry.—The announcement of the leading soap making firms that owing to the increased cost of raw materials the price of their product to the public must be raised has caused some surprise, and the justification for the increase is questioned. It is pointed out that a very important raw material for the

soap maker is cotton-oil, and that the present price of cotton-oil is not unusually high. Its price is £20 per ton "naked" in Hull, and it can be bought for forward delivery, say from November to April, at £17 17s. 6d. per ton. On the other hand its average price in 1902 was close upon £26 per ton, and nothing then was said by the soap makers as to the necessity for raising prices. In 1903 it was nearly £24 per ton, and in 1904 nearly £22. Nor is it likely to go higher than the present quotation in the near future; on the contrary, probabilities point to considerable shrinkage in price. The receipts of cotton-seed are increasing rapidly. Taking the present year the imports have been 40 per cent. greater than they were in 1905, the increase being almost entirely in seed from India, which shows that Indian cotton growers are saving their surplus seed and shipping it. Should this practice become general in India our markets would be inundated with cotton seed and values would fall heavily. Again, tallow is a very important soap material and tallow is much cheaper than it used to be. In 1902 tallow and stearine averaged nearly £31 per ton. In January, 1902, Colonial beef tallow was quoted at £35 per ton in London, and mutton tallow at £38. The present quotations are considerably below these figures. The rapid growth of the Australian flocks since 1902 would seem to warrant the opinion that notwithstanding some increase in consumption the price is more likely to go lower than higher. It will be seen, therefore, that anyway two of the principal raw materials used by the soap maker are lower in price to-day than they have been in years past when the soap makers appeared to be content with the price of their product, and that one of these materials is much lower in cost, and is likely to become considerably cheaper. It is not suggested that the facts adduced are conclusive evidence that the soap makers are raising the price of their product without adequate cause, but their explanation of their decision to do so, namely, that materials are establishing themselves upon a basis of higher values, is not self evident.

The Underground Railway Companies.—It is not only the soap makers who have decided to raise prices. The directors of the Metropolitan District Railway Company have raised fares on their lines as from September 3rd, and, to a certain extent, they have induced the Metropolitan Company to do the same. It is a bold step, and it remains to be seen whether it will be justified by results. According to the chairman's statement, the average cost of carrying passengers on the District Railway is 1·22 per passenger, and the average fare paid by workpeople, who form an important section of its passengers, is only ·65d. Obviously this class of passenger is getting more for his money than he has the right to expect, and the companies are not under obligation to carry at rates which involve this heavy loss. Increased fares may not only be justifiable, but necessary, if current rates cannot be made to give a fair return upon capital outlay, but it should be looked to as the last resort, not to be adopted until it is quite certain that working expenses cannot be reduced. It is unfortunate for the Metropolitan District Company that the electrification of its line, involving as it has done heavy capital charges—from £50,000 to £60,000 per route mile of railway—should have occurred just at the time when motor-omnibus competition has become serious, but that competition has to be reckoned with, and must become more formidable as railway fares are raised. It remains to be seen whether the motor omnibuses can be made to pay at their present rate of charge. Many experts are of opinion that they cannot, and that the profits shown upon paper would disappear if proper allowance was made for maintenance and depreciation. The same may be said of the old shallow underground railways which have not as yet sufficient experience of electrical working to gauge the cost accurately. The Metropolitan and District Railway Companies have immensely improved the service they offer to the public, which has responded to a considerable extent, but it is a difficult matter to induce the travelling public to return to a route they have discarded. Many of them are certain to do so in the case of the underground lines sooner or later, provided increased fares do not turn the scale in favour of their competitors, for they offer many advantages, but it is to be remembered that the public put cheapness in the forefront, and prefer to submit to some inconvenience if by doing so they can save a trifle.

The Boiler-making Industry.—Recently there has been increase in wages in some departments of the engineering trades and the boiler-makers are beginning to agitate for a rise. It is urged by employers that the demand is premature. The boiler-making industry has not as yet shared to any large extent in the general prosperity of the engineering business. One reason for this has been the comparatively high prices which have been exacted for material. The price of boiler plates, which was advanced during the general rise that took place in iron and steel, between September, 1905, and January, 1906, was not reduced again when the markets receded. Throughout a period of dull trade, extending from the middle of January to the end of July, a high price has been steadily maintained by the makers of steel boiler plates, and boiler makers have found it difficult to make a living profit. But the outlook is improving, and it may be taken that before long employers will see their way to make some concessions to the men.

Cotton Supplies.—The American cotton season 1905-6 was completed on September 1st, and according to one authority the figures of the crop amount to 11,345,988 bales, whilst others give 11,250,000 and 11,200,000 respectively, comparing with 13,557,000 bales in 1904-5 and 10,124,000 bales in 1903-4. The quantity of American cotton taken out of sight in the year may be put at 12 million bales. The crop of 1898-99 was much about the

same as that of last year, amounting to 11,235,000 bales, but whilst the world's consumption in that year was 10,867,000 bales, last year it was, as has been said, 12,000,000 bales. The average crop of the five years ended 1903-4 was 10,289,000 bales. These figures would seem to show that the price of cotton is more likely to rise than fall in the coming years, for the increased production of the raw material can hardly be said to keep pace with the increased demand for its manufactured produce. At the moment the situation of supply is causing some uneasiness. The crop movement is small and this just at a time when it is very inconvenient that it should be small. The shipments are equally small, and stocks here may be run down to a really low figure before various difficulties are overcome. The crop accounts from Egypt are satisfactory, and in India there has been improvement in the districts where the outlook was least favourable. The cotton exports from the colonies too may be expected to show increase, in some cases considerable, in the coming year. It is reasonable, therefore, to assume that so far as 1906-7 is concerned the supply of raw material will be sufficient, more especially having regard to labour difficulties in the Southern States of America, which are likely to restrict the home demand considerably. But it is even more probable that before many years have passed the supply of the raw material will fall seriously short of the demand unless the acreage under cotton is increased to an extent of which at present there seems little likelihood.

OBITUARY.

Charles Denton Abel.—Mr. Charles Denton Abel died on the 27th of August. Mr. Abel became a member of the Society in 1886. He was a younger brother of the late Sir Frederick Abel. Between the years 1856 and 1860 he joined Edward Cowper as a Patent Agent. The firm, which afterwards became well known as Abel and Imray, has held for many years a leading position in the profession. Mr. Abel assisted in founding the Chartered Institute of Patent Agents in 1881, and throughout almost all the years of its existence he was a member of its Council, serving as a President from 1897 to 1899. On the 14th of December, 1904, he read a paper before the Society on "The Patent Laws," and for this paper he was awarded the Society's medal.

GENERAL NOTES.

Mines in Guatemala.—Mr. H. A. R. Hervey, Chargé d'Affaires of His Majesty's Legation at Guatemala, referring (Cd. 2682) to the mineral richness of the country says that the records show that during the 200 years preceding 1820 there were no fewer than 1332 mines in operation, "many of them of fabulous richness." "It is a matter of common knowledge," he says, "that there exists in the department of Quiché a gold mine of extraordinary productiveness, but the natives jealously guard the secret of its whereabouts, and no exploring party now dares to run the risk of their vengeance by endeavouring to locate it." In Huchuetenargo there are vast bodies of silver-lead ores which are practically self-fluxing and can be smelted at ordinary fuel heat. These ores are now worked in crude fashion by the Indians, and nearly all the lead consumed in Guatemala comes from this district. Even the surface ores yield from 30 to 60 per cent. of lead. A cart road has now been built right into the heart of the mineral area. It is seldom that an official report directs attention to mineral potentialities of this kind.

The Trade of Shanghai.—The trade of Shanghas had many adverse influences to reckon with during the period covered by Mr. A. G. Major's report (3674 Annual Series) just issued. On September 1 the highest flood tide of the year occurred, and this was further heightened by a strong north-easterly gale, which increased into a typhoon, resulting in the destruction of property valued at over £1,000,000. The chief damage was done to the godowns, or warehouses, many of which were flooded, and the losses were the more serious as they happened to be heavily stocked at the time. Then in the earlier part of the year the war continued to interfere with trade, stopping it with the northern ports and from adding the risks to shipping from mines and capture. The boycott of American goods, too, had a disturbing effect, and a riot in December caused a complete cessation of business of almost all kinds for two or three days. Notwithstanding these adverse influences the trade of Shanghai in 1905 was largely in excess of that of the preceding year. Taking the five years ended December 31, 1905, there was, with the exception of 1903, a steady increase, and the figures of 1905 are about double those of ten years earlier. This continual increase in the trade of the port indicates growing prosperity throughout China, for the trade of Shanghai is chiefly that of a redistributing centre for imports, and a port of reshipment for exports. British trade maintained its position, and British cotton goods especially show a large increase in shirtings, sheetings, drills and T-cloths. Of the tea exported approximately 38,400 cwts. of black (Congou) went to the United States, 25,480 cwts. to the United Kingdom, 18,720 cwts. to Russia, and 11,625 cwts. to Germany. Of green 24 per cent. was exported to Russia and 45 per cent. to the United States. Of a total tonnage of vessels entered and cleared during the year of 14,344,162 tons, 7,139,843 tons were British, Chinese steamers and junks totalling 2,062,992 tons, and German 1,628,084 tons.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

PRIZES FOR INDUSTRIAL DESIGN.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wallpapers, and Hangings, Damasks, Chintzes, &c., regulated by the principals laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked, "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1907, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

EXAMINATIONS.

The Programme for 1907 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. (post free 4d.). Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The Examinations are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The subjects include: — Book-keeping, Accounting and Banking, Shorthand, Typewriting, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages.

The Examinations will commence on Monday, April 15, 1907.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted in each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates will be given; in Harmony Higher, Intermediate, and Elementary Certificates.

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments of Music are the same as for Stages II. and III.

Medals and Prizes are offered in each subject in Stages II. and III. Full particulars will be found in the Programme.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

HOWARD LECTURES.

HIGH-SPEED ELECTRIC MACHINERY,

WITH SPECIAL REFERENCE TO

STEAM-TURBINE MACHINES.

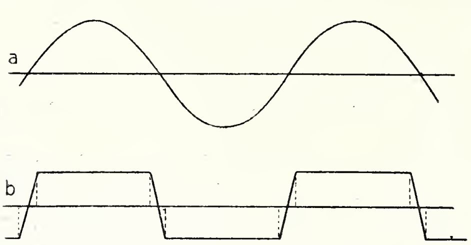
By Professor Silvanus P. Thompson, D.Sc., F.R.S.

Lecture II.—Delivered January 25th, 1906.

Continuous Current Generators.

In all so-called continuous-current generators (excepting those of the rare species called *homopolar* or *unipolar*), the current within the armature is necessarily alternating, because the conductors move past north poles and south poles in alternate succession. But these internal alternating currents differ from those of ordinary alternators in respect of their wave-form. So far from this being even approximately a sine-curve, Fig. 6, *a*, it consists of a number of rectangular or nearly rectangular portions, having for considerable fractions of

Fig. 6.



Wave Forms of Alternating Currents.

each half-period a constant ordinate, but which pass abruptly during much smaller portions of the half-period from a positive to an equal negative nature, as in Fig. 6, *b*. The current in any one armature conductor passes, in fact, from the value $+ C_1$ to the value $- C_1$ during a brief interval of transition, lasting usually only from 1-20th to 1-10th of the half-period, or let us say lasting from 1-800th to 1-200th of a second.

Each armature conductor forms part of a loop or coil of the armature winding. In the simplest case it constitutes one "side" of a simple loop or element, connected at one end to a segment of the commutator, and at the other end to an adjacent segment, each of these "sides" of the loop being embedded in a slot of the armature core.

It is not possible, when a current is flowing around any loop, to stop that current instantaneously, nor, having stopped the current, is it possible to start it again instantaneously in the reversed direction around the loop. The dying away and the growth of a current both require time. This is because of the interlinkage of the current itself with the magnetic lines of its own creation in the space surrounding itself. There have been many attempts made to find simple approximate rules for the amount of interlinkage of a current with its own magnetic lines.

A conductor of round or square section lying in air is estimated to create in the space surrounding itself 4 magnetic lines per ampere for each inch length of the conductor. This is a coarse approximation only; for if the conductor is very small, say, a wire 1-40th inch in diameter, and 1 ampere passes through it, that ampere can set up a much more intense field around the wire than if it were flowing in a wire $\frac{1}{4}$ of an inch in diameter, distributed through one hundred times the cross-section. Or, again, if a current is flowing in a round wire $\frac{1}{4}$-inch diameter, the field which it sets up around itself will be denser than that which the same current would set up if flowing in a flat ribbon of equal section, say 1 inch wide and 1-16th inch thick. Now, in large continuous-current dynamos the conductors are nearly always flat strips, not round wires, and, as they usually have to carry from 100 to 150 amperes (at full load), and have a current density of 2,000 amperes per square inch, the strip will usually have a section of from 1-20th to 1-12th square inch. The magnetic field surrounding such a strip, in air, may be taken to produce, with a current of 100 amperes, about 200 lines per inch length of strip, or about 2 lines per ampere per inch.

If the strip is embedded in a slot between iron teeth, the amount of throttling magnetic flux which each ampere will set up around each inch length so embedded will be considerably greater than is the case with non-embedded strip. According to the best authorities, a strip embedded in a narrow slot open at the top may be taken to set up 10 lines per ampere per inch.

Let us now consider the total interlinkage of magnetic lines that will occur in a concrete case. Suppose a generator in which there are 100 amperes in each conductor, and that each loop of the armature consists of 36 inches of embedded length and of 48 inches of free length. Then, according to the foregoing data, the total surrounding magnetic flux will be

$(36 \times 10) + (48 \times 2) = 360 + 96 = 456$ lines per ampere, or 45,600 lines per loop. Or, taking the embedded and free parts together, the linkage will be 456 lines per ampere. Let us call the number of lines of linkage per ampere by the symbol L, so that here $L = 456$. Now, suppose that the time allowed for commutation was only 1-500th of a second, and that (though the assumption can never be quite accurately fulfilled) the current could change from + 100 to − 100 amperes at a perfectly uniform rate during that time—that is, could alter by 200 amperes in 1-500th of a second. This is at the rate of 100,000 amperes per second. Now, without stopping to prove the rule, we have

$$e = - L \frac{dC}{dt} = - (456 \times 100{,}000)$$

where L is the linkage, and $\frac{dC}{dt}$ is the rate of change of the current. Hence, putting in the values, we get:—

$$e = - 45{,}600{,}000 \text{ lines per second,}$$

or dividing by 10^8 to bring to volts, we have

$$e = - 0{\cdot}45 \text{ volts.}$$

The minus sign signifies that this is a reaction, the self-induced electromotive force opposing the change of current. This opposing self-induced electromotive force is sometimes called the "reactance voltage," though it is not always calculated so simply. There can be no commutation free from such a reactance voltage; and the reactance voltage always tends to delay the reversal. It is because of such reactance voltages that the current takes time to be commuted.

The Problem of Commutation.

Having thus stated the main fact that the reversal of current is a process requiring time, it becomes obvious that into the commutation problem in its very simplest form, apart from all theories of self-induction, there enter considerations as to the surface-speed of the commutator, the breadth subtended at the surface by each commutator segment, and the breadth of the brush. For the time, T, from beginning to end of the commutation will be directly proportional to the sum of the peripheral length of the brush arc of contact and the thickness of the mica insulation between segments, and inversely proportional to the peripheral speed. Thus, if we have a brush arc of 0·75 inch, a thickness of 0·030 for the mica, and a surface speed of 1,000 inches per second, the duration will be 0·00078 seconds.

Now, brushes are either of metal—that is copper gauze or brass wires—or of carbon, and the breadth of the contact arc of the former is always much less than that of the latter. Carbon brushes, by the mere circumstance of their greater breadth, give a longer time for reversal. But since, during the reversal period, the coil or loop is short-circuited, the use of an unduly broad brush may lead to a wasteful heating, for during this period the coil may, under certain circumstances, be the seat of a vastly-increased parasitic current.

On the other hand, if the commutation were not completed during the time allotted to it there would be sparking at the brushes.

The problem is elucidated by consideration of the graphic diagram Fig. 7, in which the

Fig 7.

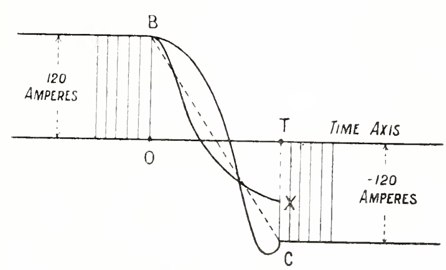


Diagram of Commutation.

horizontal line is the axis along which time is measured; and the ordinates represent the value of the current in one conductor, taken here as 120 amperes. This current is flowing in the conductor in the positive direction up to the instant when commutation begins. When commutation is over, the current in the conductor will have been reversed, so that + 120 amperes will have become − 120 amperes. This reversal must have been accomplished in the time represented on the horizontal line from O to T. Now in the preceding numerical calculations it had been assumed that this change of current took place at an absolutely uniform rate: or in other words, that the sloping dotted line in Fig. 7 represented the values of the current during the time between O and T. This is, however, an ideal case, never realized in practice, because the rate at which the current changes is never uniform. From such experiments as have been made, it appears that the straight line might well be replaced by one of the curves drawn in the figure. One of these shows "under-commutation," ending prematurely at X; the other shows "over-commutation," where the current

has reversed to an excessive amount before the period of commutation is over. Until in any given case we know more about the rate at which the current is reversed, it is impossible to give actual values of the reactance voltage. This we know, that in the vast majority, if not in all, of the actual cases, the reactance voltage has different values at different parts of the period.

Since the introduction of carbon brushes some fourteen years ago, engineers have had much less trouble with commutation than before. For with metal brushes not only was it necessary to have a much more precise setting of the brush at a particular position than is found to be the case with carbon brushes, but the position of sparklessness varied with the load, requiring continual adjustment. In the early days, when machines were run under far easier conditions (on lighting loads) it was not uncommon to have standing in attendance on each dynamo, a man, wearing blue spectacles, whose sole duty it was to shift the brushes to suit the fluctuations of the load. It is scarcely too much to say that, with the variable loads that occur in tramway work, the use of carbon brushes makes all the difference between failure and success.

In recent years engineers have learned what a vital part in the problem of satisfactory commutation is played by the resistance of the contact film between the brush and the surface of the commutator. Down till about 1899 or 1900 engineers still clung to the old theory of Hopkinson of the reversing field, although for some time it had been evident, in view of the fact that commutation could be obtained sparklessly on motors without giving the brushes a lead either way, that this theory was wholly inadequate. We may, in fact, conveniently consider commutation under two heads, as *natural* commutation, and *forced* commutation. The former depends on the natural reversal of the current as the result of the resistance of the brush contact film, the latter depends on the introduction into the coil, during commutation, of an induced voltage (due to movement in a magnetic field) to force reversal to occur. In the majority of generators both actions are made use of jointly, but it will be convenient to consider them separately.

Natural Commutation.

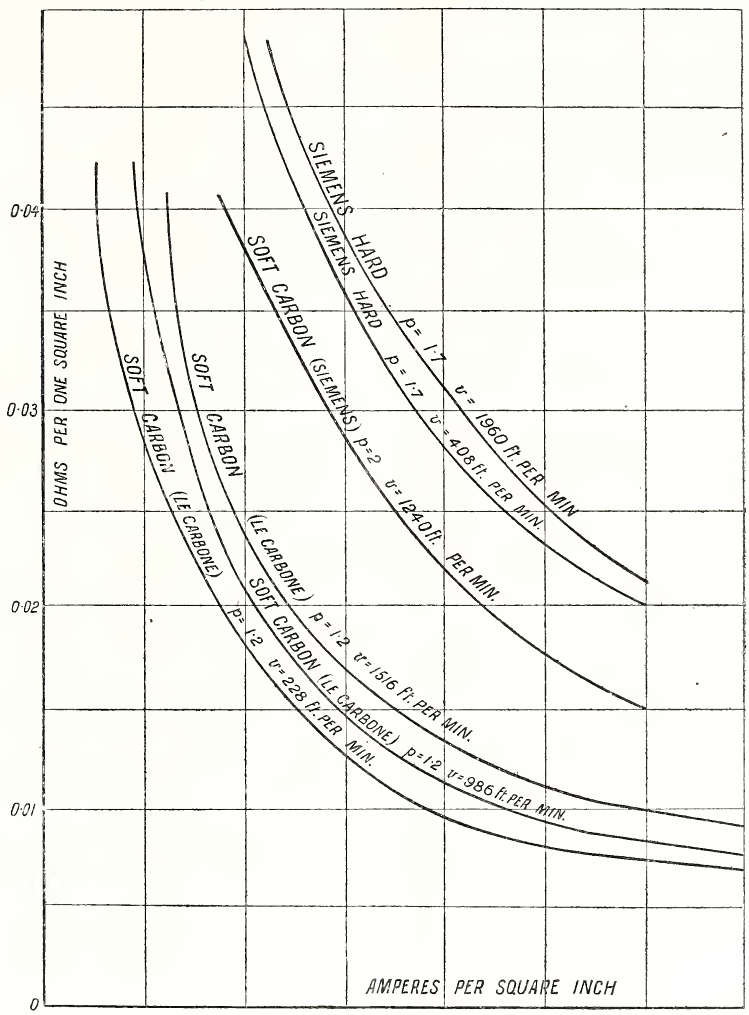
Natural commutation is brought about by the operation of the film-resistances through which the current must pass, and which by varying approximately inversely as the areas of contact, govern the admission or exclusion of the current through particular routes. In 1901, at the Engineering Congress in Glasgow, I pointed out the close analogy between this operation and the slide-valve of a steam engine. Just as the slide moves over the port-holes of the valve-chest, opening one passage for the steam and closing another, or opening it to the exhaust, so the commutator segments as they glide under the brush contact surface open, as it were, one path for the current while they close another, or open it for a reversed current. This shearing action which occurs in natural commutation under the surface of the carbon brush is due to the presence of a film of high resistance between carbon and copper. In using the term "film," I am not to be understood to assert dogmatically that there is present anything in the nature of a layer of air or other material between the surface of the brush and the surface of the commutator, but something analogous to a film there must be, since it is difficult to conceive of any mere surface, *per se*, as having a resistance. That which occurs between the two surfaces is doubtless a kinetic phenomenon of a complicated kind, the layer being the seat of molecular contacts that are continually broken and made, the points in contact being numerous, and because of the heat liberated there at every contact point, the particles will be subject to violent molecular movements. There will also, doubtless, be in the layer electric discharges, convexion currents, transferences of ions and of electrons, such as occur in the contact layers of microphones and coherers. Before we can formulate any complete theory of commutation, it is important to obtain a clear view of such facts as have already been observed as to the resistances of contact-films under different conditions. A review of such facts will be itself extremely useful for future guidance in practice, and therefore has a distinct value independently of all theories. Experiments have been made by Professor E. Arnold (see the *Elektrotechnische Zeitschrift*, 1899, p. 5), and by Herr M. Kahn (see his monograph in Vol. III. *Sammlung Elektrotechnischer Vorträge*).

Fig. 8 gives in the form of graphic curves the results of experiments upon a hard and a soft carbon of Siemens, and upon some soft carbons of the quality denoted "X" of the firm of Le Carbone. The resistance between the carbon face and the copper surface beneath it was measured under different pressures, and with different densities of current, as marked

on the curves. Also different velocities of movement of the copper beneath the brushes were given to observe the effect.

From an inspection of these curves several facts at once come to light. The harder the carbon the higher is the resistance offered by the contact-film. More important is the fact that with increase of current density the resistance goes down; and indeed varies almost inversely with the density. For example, with Siemens' soft carbon, under a pressure of 2 lbs. per square inch, and at a surface speed of 1,240 ft. per minute, the resistance of one square inch is about 0·0375 ohms when the density is 20 amperes per square inch; and when the density is doubled the contact resistance of the square inch falls to 0·022. Increasing the speed causes a slight increase in the resistance: at a density of 40 amperes per square inch, with the soft carbon of Le Carbone, under a pressure of 1·2 lb. per square inch, the resistance which was just under 0·01 ohm at a surface speed of 228 ft. per minute, went up to only 0·0135 when the speed was increased to 1,516 ft. per minute.

Fig. 8.



Relation between Current-density and Contact-resistance, for different kinds of Carbon.

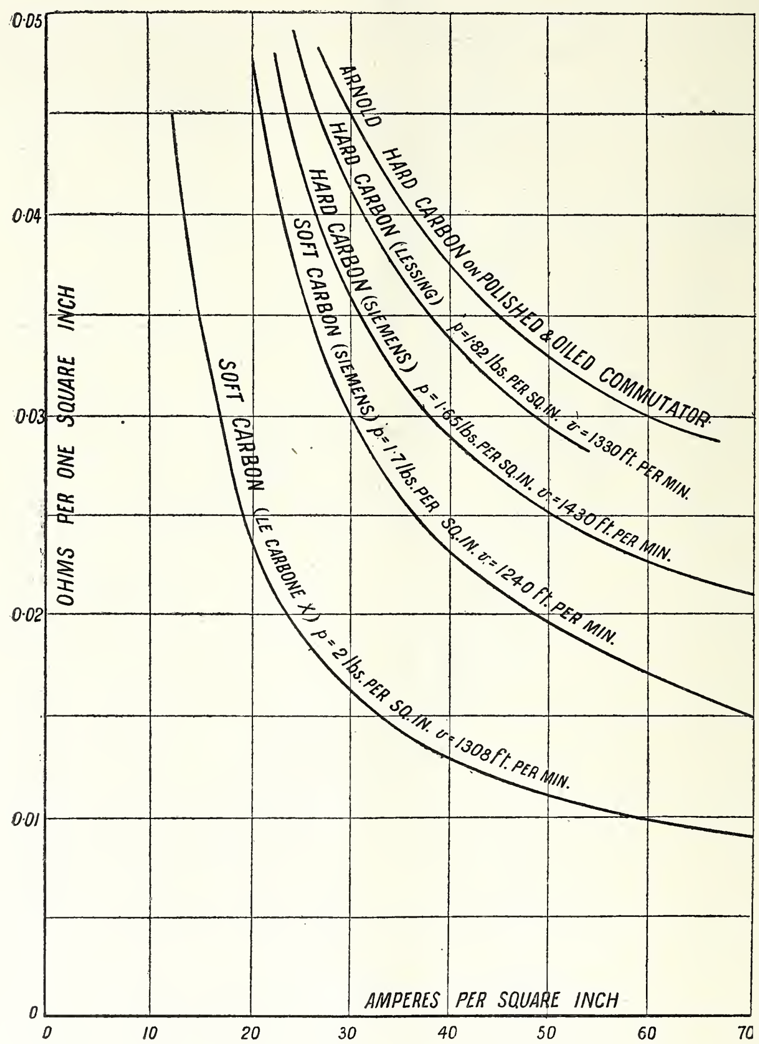
Fig. 9 gives an independent set of results with different varieties of carbons under usual pressures and velocities. A curve has been

added from Arnold's observations, showing that with a polished commutator, well-oiled, the resistance is increased.

The effect of increasing the velocity is well shown in the curves of Fig. 10, which were obtained with very hard Austrian carbons under a pressure of 1·35 lb. per square inch, and at two different current-densities. The contact resistance of 1 square inch, with a density of 33 amperes per square inch, was about 0·03 ohm with zero velocity. At 500 feet per minute the resistance increased to 0·0415, and at 1,000 feet per minute to 0·0451, after which any further increase in surface speed made but a slight increase of the resistance.

If the resistance for 1 square inch be multiplied by the amperes per square inch, one obtains the voltage required to drive the current through the film, in other words the contact-voltage. As the two factors vary approximately in inverse proportion to one another, the product is approximately constant, and is of the order of 1 volt for hard carbons. Fig. 11 shows the values for the hard carbon and the soft carbon of Siemens. With soft carbons the value is about 0·5 volt, or under. The values for copper brushes are much lower; but there is a curious discrepancy between the results found by different observers. Dettmar finds the value of 0·1 volt, increasing regularly

Fig. 9.



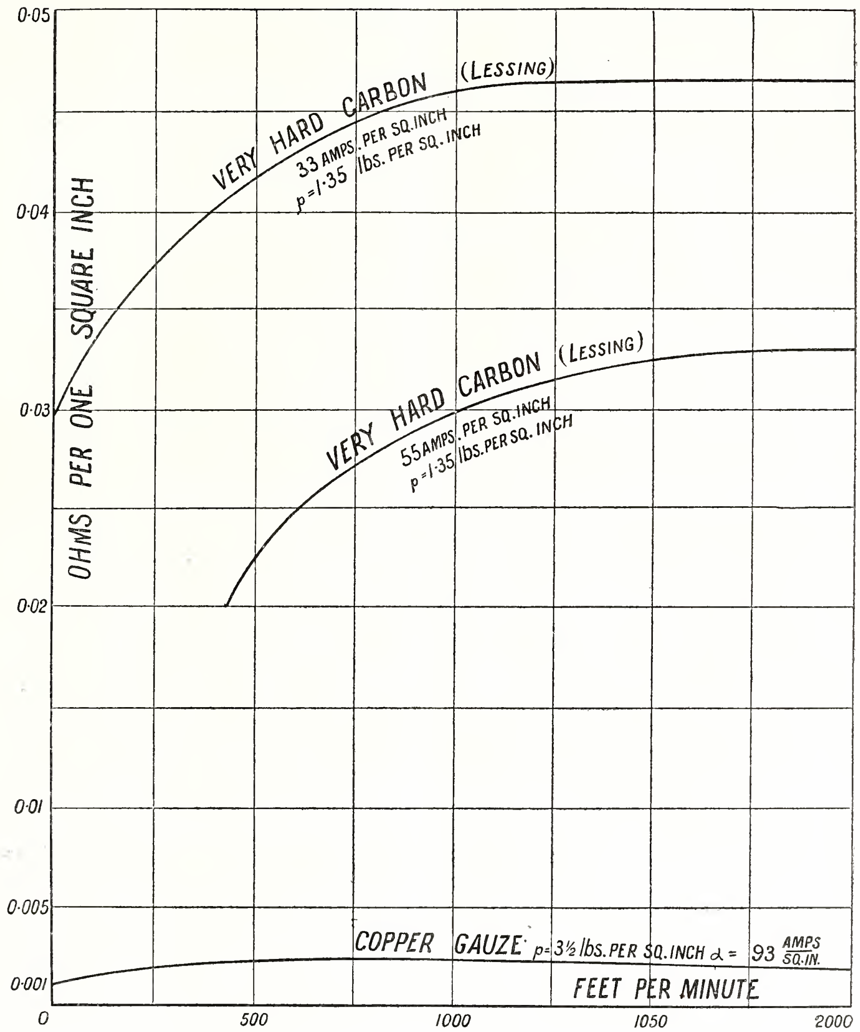
Relation between Current-density and Contact-resistance.

with the current density, and attaining 02·5 volt when the density is raised to 124 amperes per square inch. Arnold, on the other hand, finds a value of 0·01 to 0·2 volt. Pressure and surface speed make comparatively little difference to the contact resistance of copper brushes. There appears to be a maximum value at somewhere about 800 feet per minute.

The lowness of the contact resistance of copper brushes prevents them from assisting commutation in the way that carbon brushes do. On the other hand, the contact-voltage of carbon brushes being about 1 volt, that is 2 volts in total at the positive and negative brushes of the machine, they are not suited for machines of very low voltage such as those used for electroplating, since such a voltage-drop is too serious a fraction of the whole electromotive force of the machine.

Fig. 12 gives three sets of curves relating to the pressure. For the hard carbon of Lessing, the curves given show how, at a given density of current and speed of surface, the contact resistance is diminished by increasing the pressure. With ordinary dynamos and the usual carbons, the pressure found best in practice is from $1\frac{1}{2}$ to 2 lbs. per square inch. If a lighter pressure is used the resistance is too high; and if the machine is not in perfect balance, or the commutator not per-

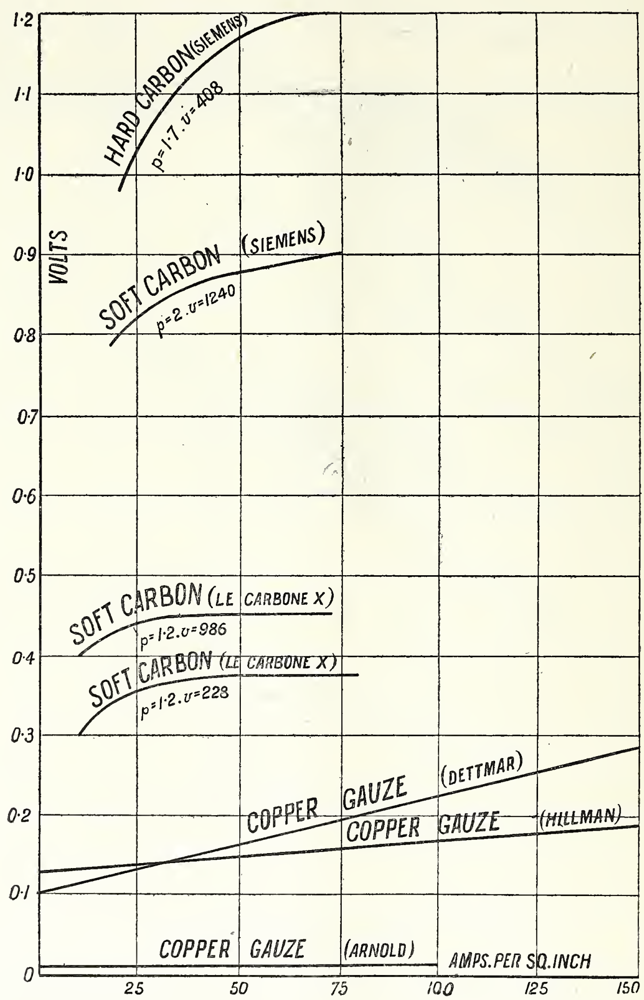
Fig. 10.



Relation between Surface-speed and Contact-resistance.

fectly true in outline, the brushes are apt to chatter. On the other hand, if the pressure is too great, the commutator is apt to be scored and cut by the carbons, if they are hard; or, if they are soft, the commutator surface becomes smeared, tending to provoke flash-over of the sparks. Friction at the commutator is, indeed, a not unimportant question. In the lower part of Fig. 12 are given graphs of the friction losses in watts per square inch at three different speeds. Taking for example a pressure of 2 lb. per square inch, and a surface speed of 2,000 feet per minute, it appears that the friction losses amount to about 19 watts per square inch of brush contact. If we calculate out the watt-losses (per square inch) due to the resistance and to friction, we obtain the total commutator losses per square inch. As the resistance losses go down, and the friction losses go up, with increase of pressure, there will be for each kind of carbon and each assigned speed one particular value of pressure which makes the total commutator losses a minimum, as may be seen from the upper curves of Fig. 12. In designing ordinary generators it is safe to admit a loss of 60 watts per square inch of brush-contact.

Fig. 11.



Relation between Current-density and Contact-voltage.

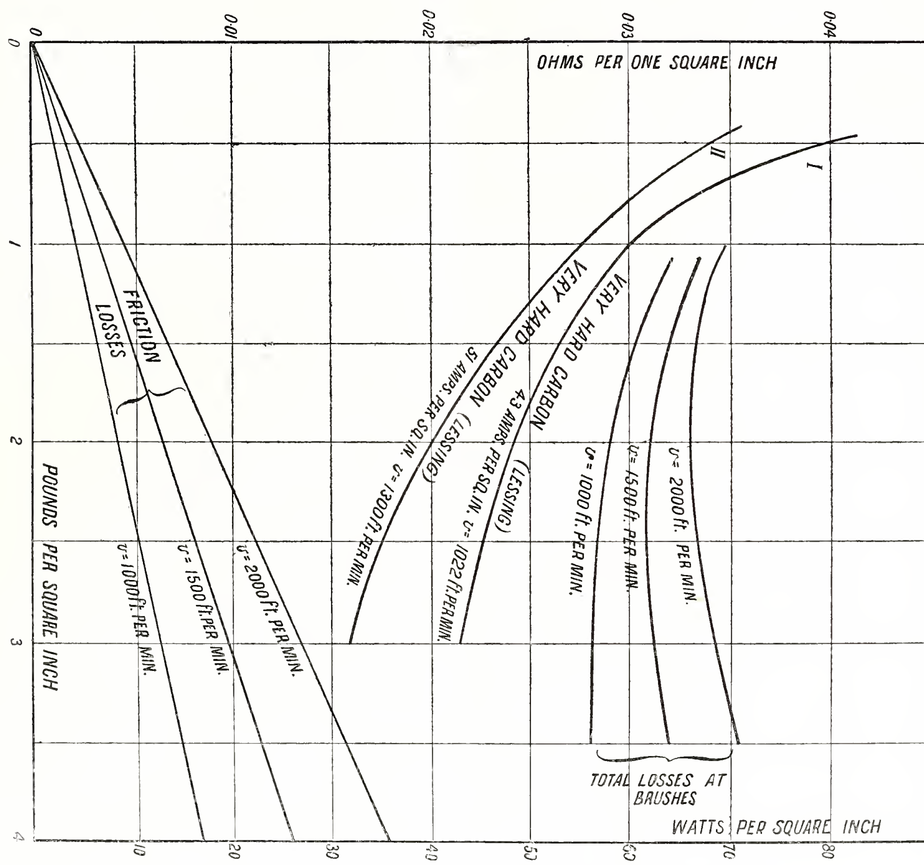
Taking commutators as they are in ordinary dynamos, with carbon brushes, and assuming surface speeds not exceeding 3,000 feet per minute, and pressures not exceeding 2 lb. per square inch, we may then assume that they present, at the contact-film under the brushes, a transition voltage of from 0·8 to 1 volt.

Careful observation shows that the value at the negative brush (where current flows from carbon to copper on re-entering the armature) is slightly higher than that at the positive. As a result the heating is slightly greater. From the energy point of view the presence of this contact-resistance is a loss of economy and undesirable. But its presence is the whole secret of success in natural commutation. The price paid for the sparkless working of the machine is the voltage-drop of 1·6 to 2 volts.

The theory of natural commutation by means of the contact resistances is very simple, and for the consideration of the ideal case needs no mathematical formulæ. It will be readily grasped by considering a concrete example, illustrated in the sketches of Fig. 13.

In this we suppose the brush to cover two segments, each $\frac{1}{2}$ inch in width, and that the total brush-length in the direction parallel to the axis is 3 inches, having, therefore, 3 square inches of face. Let this brush be collecting 120 amperes. The current-density will be 40 amperes per square inch. Fig. 13 *a* represents the state of things when the brush is collecting current from the segments marked Z and A; 60 amperes coming from the armature winding on the right, and 60 from the winding on the left. The element of winding which lies between A and B carries its full 60 amperes flowing from B towards A.

Fig. 12.

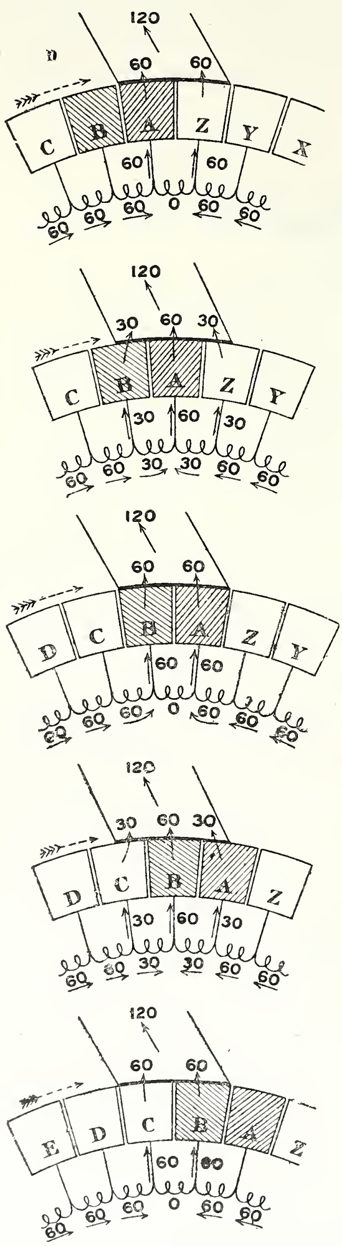


Relation between Pressure and Contact-resistance.

Now suppose the commutator to have moved on a little to the position shown in Fig. 13 *b*. The segment A still makes full contact, and will deliver its 60 amperes, but Z will have a reduced surface for delivery, and now an additional surface has come into play at B; the resistance over Z will have increased. Hence the current carried by the element of winding that lies between A and B is reduced, as shown. If the other resistances that lie between the segments through the risers and the windings are relatively small, the distribution of the current will be governed by these

resistances at the surface, or rather would be so governed if the charge of current-strength were not retarded by self-induction. Assuming that the self-induction is negligibly small, it is obvious that the flow of current will be regularly shifted, and that the flow through Z will regularly diminish exactly as the flow through B increases. At the next stage, Fig. 13 *c*, Z has passed on, and B carries full 60 amperes. Then as the riser leading from the windings to A carries 60 amperes, and as that leading from the windings to B carries 60 amperes, the element of winding that lies between A and B will not carry any current. The act of commutation of the current in that element is now half over. During the next half-period the current in that element will increase again to 60 amperes in the reversed direction. For, as shown in Fig. 13 *d*, when the commutator has moved another stage forward the contact surface of A has diminished, reducing the amount of current that can pass through the film to the brush, while a new path has been opened through the contact surface of C. Unless there is any retardation of the changes, it will be obvious that when the last stage (represented in Fig. 13 *e*) is reached, the process of commutation of the current in that element of winding will be complete, and the current carried by the element will be 60 amperes flowing toward B.

Fig. 13.



a. Instant before commencement of commutation in the section A B.

b. End of first quarter of the period of commutation in the section A B.

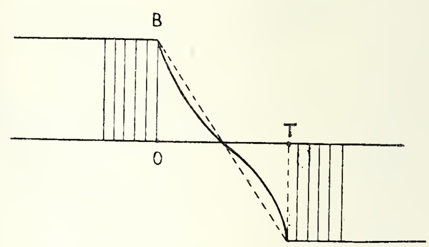
c. End of second quarter of the period of commutation in the section A B.

d. End of third quarter of the period of commutation in the section A B.

e. Commutation in the section A B completed.

Stages in the Process of Commutation.

Fig. 14.



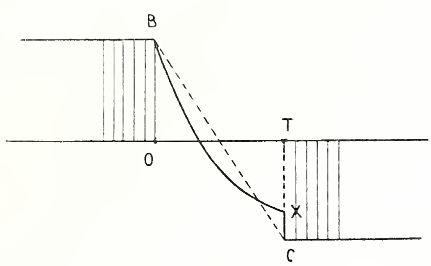
Effect of Resistance of Loop on Commutation Curve.

But though this is the ideal operation, it is only realised in those cases where the resistance and reactance of the element of winding are so small as to be negligible compared with the resistance of the contacts at the surface of commutation. But some resistance and some reactance are always present, and their effects must be taken into account. Resistance by itself has no effect on the whole operation: it assists the process of commutation during the first half of the period, and causes the current to die down at first more rapidly; but it hinders the process of commutation during the second half period, causing the reversed current in the element to grow less rapidly than it otherwise would do. In fact, the presence of resistance, whether in the actual element of winding, or in the risers that connect it to the segments of the commutator, tends to modify the process in the manner indicated graphically by the inflected curve of Fig. 14. There is, in fact, no justification for the custom adopted by some

designers of using risers made of German silver or of rheostene or other alloy of high resistance in the hope of improving commutation. All unnecessary resistance involves needless loss of energy and useless heating. Whatever, therefore, may be the ulterior advantage claimed for the use of such auxiliary resistance in the case of alternating current motors, where there are parasitic induced currents to be considered, in continuous-current armatures such resistance is to be avoided. A better place to put it is in the brush-films, where it is useful.

On the other hand, the reactance of the element of winding has a dominant effect on the process of commutation. Wherever reactance occurs it inevitably delays change. It causes the current in the element of winding to die down more slowly during the first part of the process, so that commutation is not half

FIG. 15.



EFFECT OF SELF-INDUCTION ON COMMUTATION CURVE.

over by the end of the first half of the time. It also causes the reversed current to grow more slowly during the second half, with the result that at the moment when commutation ought to be completed (as shown in Fig. 13 *e*, where the segment A is just parting from contact with the tip of the brush) the current has not yet attained its full value. The general effect of the presence of reactance may therefore be stated graphically by a curve such as that shown in Fig. 15, where the current curve which ought to go down to C falls short and only goes to X. The length X C gives an idea how far the commutation falls short of being complete, and is to a certain extent a measure of the probability that the machine will spark.

FORCED COMMUTATION.

Down to this point I have been dealing with the natural commutation brought about by the contact resistance of the brushes. But the older method, which was introduced when metal brushes were in vogue, is the method of *forced commutation* in which the reversal of the current in the element of winding is aided by the introduction, during the allotted period, of an induced electro-motive force. There are two plans for the production of this reversing electro-motive force: (i.) to give a lead to the brushes, (ii.) to provide a special reversing magnetic field by the aid of an auxiliary pole. The theory of the brush-lead to obtain a reversing electro-motive force was given by the late Dr. John Hopkinson. The theory of the auxiliary reversing pole is more simple, since it is not complicated by any question of angular displacement. For sparkless reversal there is needed, during the period of commutation, an electromotive force sufficiently great to neutralize the electromotive forces due to reactance. Therefore, the narrower the brush, the shorter is the time alloted, and the greater must be the auxiliary induced electromotive force. Moreover, at small loads, small electromotive forces only are needed; hence it follows that the excitation of the auxiliary pole ought to be procured by use of a series winding. Also, at full load, if the field of the auxiliary pole is not to be neutralized by the magnetic reaction of the armature, the ampere-turns of excitation upon it must be slightly greater than the number of armature ampere-turns per pole. We shall return to this matter presently.

If, as is the case with reversible motors, a machine is required to run sparklessly in either direction, then it is impossible to give the brushes a lead in order to force the commutation. The brushes must be fixed in the neutral position; and the commutation must be natural, or else auxiliary poles must be used to force the commutation. For ordinary generators rotation in one direction only is the rule. For these, then it is possible to provide a forced commutation by giving a forward lead to the brushes. Theoretically this lead should increase with the load, as indeed was the plan used twenty years ago, the rocker being adjusted by an attendant at every change of the output. But this being quite impracticable with tramway generators, the brushes must be set in a fixed position. This is usually chosen at about the position suitable for half-load; and with carbon brushes of ordinary breadth, natural commutation suffices to make the collection of current sparkless at the extremes of no-load and full-load, though the commutating field, *per se*, is too strong for no-load and too weak for full-load.

One result of this compromise is that at low loads there may be over-commutation, the cur-

rent being reversed to a value exceeding the required amount; in such a case the commutation curve becomes re-curved as in one of the alternative forms in Fig. 7.

The problem of securing a sparkless commutation at all loads, and with an invariable position of the brushes, was practically solved for ordinary slow-speed generators by the introduction of the carbon brush, and the design of the machine, with saturated armature teeth and a stable magnetic field.

We shall see hereafter how this problem has cropped up afresh in the particular case of turbo-dynamos.

Criteria of Commutation.

Many different criteria have been proposed to determine beforehand whether the commutation of a machine of given design will be satisfactory or not. For while the normal out-put of a generator may be temporarily exceeded by overloads of 25 to 50 per cent. without damage from overheating, or mechanical injury to the machine, if severe sparking is set up, even for a few minutes, the commutator will be damaged. It is then the sparking question which limits the normal rating of the machine. Two useful empirical rules were early given by Kapp. Arnold who has investigated the question of commutation with the utmost elaboration has also formulated certain rules. Hobart has given a rule in which the reactance-voltage is compared with the average voltage per segment. Several other rules have been suggested by various writers or used by different firms. The following is a compendium of the chief rules.

1. *Value of Commutating Field.*—

$$B_k = B_g (AT_{2g} - AT_x) \div AT_{2g} ;$$

where AT_{2g} stands for the ampere-turns needed to drive the flux across the two gaps in a magnetic circuit, and AT_x is the cross-magnetizing ampere-turns per pole. In this rule it is assumed that the reduction of the flux under the pole-corner, in the neighbourhood of which commutation is to take place, is proportional to the reduction of the ampere-turns by reason of the cross-magnetizing effect. Such a formula is clearly only applicable to cases in which by giving a lead to the brushes a forced commutation is sought. If the value of this commutating field B_k falls below about 40 times q, or say below 25,000 lines per square inch, there will be trouble with the sparking.

2. *Stiffness Ratio.*—

$$B_g \div q = \text{from 80 to 100.}$$

If B_g is too low or q too high, so that this ratio falls below 80, trouble may be expected. because a high value of q implies a great distorting tendency, which must be fought by providing a dense field in the gap.

3. *Commutation Ratio.*—

$$\frac{B_g}{q \times e_k} = \begin{cases} \text{from 27 to 33 in 100-volt machines.} \\ \text{from 12 to 16 in 500-volt machines.} \end{cases}$$

Here e_k signifies the average voltage per segment of the commutation.

4. *General Electric Company's Rule.*—

$$\frac{AT_{2g} + AT_{2t}}{b \times q} = \text{from 1·3 to 1·5 at least.}$$

Here $b \times q$ is the number of ampere conductors at any moment under one pole, tending to distort; and the rule says that the number of ampere-turns of excitation spent on sending the useful flux across two gaps and along two teeth in the magnetic circuit must be from 1·3 to 1·5 times as great. Like Rule 2, this rule is an attempt to state a working proportion between the causes which respectively resist and produce distortion.

5. *Auxiliary Pole Rule.*—The preceding rules are for the case of ordinary dynamos; but where auxiliary poles are used the following rule is a useful guide:—

$$\frac{B_{aux}}{q \times l_i \times z} = \text{at least 3.}$$

Here B_{aux} is the value of the field beneath the auxiliary pole, l_i the nett length of iron in the armature core parallel to the shaft, and z the ratio of the number of conductors in the armature to the number of segments in the commutator.

6. *S. P. Thompson's Figure of Merit.*—I have found a useful criterion to be afforded by the following empirical formula, in which I place in the denominator those quantities the increase of which is known to be bad as to their effect on commutation, and so obtain a figure of merit, j, which varies in different machines from 1·25 to 6; but which should never fall below 1. The bigger it is, the greater is the factor of safety of the machine.

$$j = \frac{10^8}{l_i \times q \times v_k \times z} = \text{from 1·25 to 6, or more.}$$

Here v_k is the surface speed of the commutator, in feet per minute. All the quantities concerned are armature quantities. The formula says nothing about either the qualities of the brushes, or the disposition of the magnetic field or its fringes. It may be regarded, therefore as a means of comparison between different armatures as to their probable performance in similar field and brush conditions.

7. *Hobart's Rule.*—Hobart has given the rule that the ratio of the reactance-voltage (calculated in his particular way under the

assumption that the current during the commutation-period varies as a cosine curve and not as a straight line), to the average voltage per segment should be less than unity; or—

$$\frac{e_r}{e_k} < 1.$$

For my own part I have never been able to see what the average voltage per segment has to do with the question, since, in all cases where one relies on a lead of the brushes to force the commutation the average voltage is not in the least a measure of the strength of the commutating field in the neighbourhood of the pole tip. More recently, in his paper at the Glasgow Congress, Mr. Hobart has stated that he no longer attaches any particular importance to this ratio; so that reactance voltage becomes a mere number, useful for comparing the probable reaction of one armature with that of another. If this is admitted, then it can be calculated much more simply by the formula:—

$$e_r = \frac{0{\cdot}21}{10^8}\left\{ U\, m^2 K C_1\, (10 l_i + l_a) \right\};$$

where U signifies the revolutions per minute, m the number of turns per armature coil, K the number of commutator segments, C_1 the current in 1 conductor, l_i the nett iron length of the armature, and l_a the length of coil free in air at the end-bend of the winding at one end of the coil.

8. *Arnold's Criterion.*—Professor Arnold has given a formula in which he attempts to take into account not only the reactions of self and mutual induction, but also the specific properties of the carbon brush, in building up a formula for the value of the *final potential difference* which appears between the toe of the brush and the retreating edge of the commutator segment. This final potential difference thus becomes a criterion of the probable performance of the machine, since in a machine that is not to spark its value must lie under 4 volts, and preferably should not exceed 2 volts. The calculations are complicated, but if we assume as the mean position of the brushes that corresponding to satisfactory performance at half-load the formula becomes

$$P_T = \frac{e_M + e_q}{1 - \dfrac{e_s}{P_W}}$$

where P_T is the final potential difference; e_M the voltage induced in a coil by the commutation of the current; e_q the voltage induced in a coil by the change of flux-density in the commutation zone by reason of cross magnetisation; e_s the effective voltage of the apparent self-induction of the short-circuited coil; and P_W a voltage dependent on the material of the brushes, having values lying for ordinary sorts of carbon between 0·6 and 1 volt.

9. *Arnold's Second Criterion.*—Arnold further says that $\frac{P_W}{e_s}$ should be not less than, but preferably greater than unity. This implies that the carbon voltage P_W should be as high as possible, or that to keep e_s low the mutual induction of the simultaneously short-circuited coils should be great compared with the self-induction of one coil; or, in other words, that the breadth of brush should be sufficiently great to cover two or three segments at least.

10. *Kapp's Criteria.*—Professor Kapp has given two criteria, as follows:—

$$Y_1 = \frac{B_g \times x}{q}$$

$$Y_2 = \frac{K \times \delta}{(d\lambda + x)}$$

where x stands for the number of segments covered by the breadth of the brush; the width of the air-gap; d the diameter of the armature. Then, he says, a machine will not be satisfactory as to commutation unless Y_1 is at least as great as 38; nor unless also Y_2 is not less than 0·6 for carbon brushes, nor less than 1·2 for copper brushes.

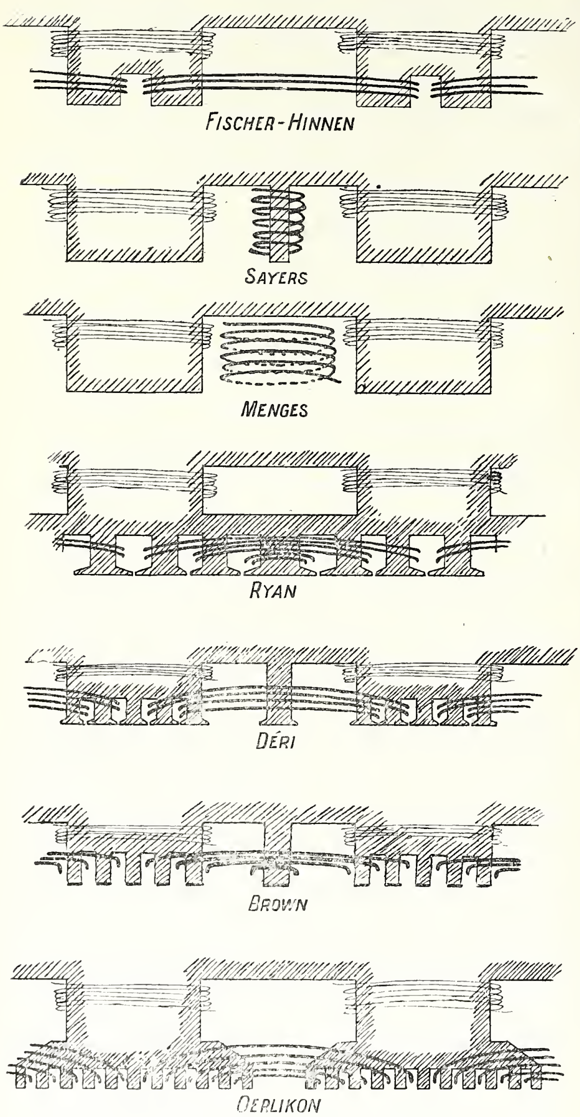
I have tested the various criteria on a large number of standard machines, and have found none of them to give a truer indication than No. 6, though they are all useful in their several ways.

Compensating Windings and Auxiliary Poles.

Ever since the time when the existence was recognised of the magnetic distortion produced by the armature currents, in consequence of their cross-magnetising action, proposals have been made for neutralising their effect by means of compensating windings. As the distorting magneto-motive force is proportional to the armature current, it is self-evident that the compensating coil ought to be a thick wire coil inserted in series with the armature. Then assuming that the compensating coil is wound with a sufficient number of turns to make the compensating ampere-turns equal in amount to the armature ampere-turns per pole, the only remaining questions are whether the compensating coil should be wound in a concentrated or in a distributive manner, and how such winding may most conveniently

be disposed. Various modes of arrangement are shown in Fig. 16. One of the oldest plans, due to Fischer-Hinnen, had a concentrated compensating winding sunk in deep notches at the middles of the pole-faces. Sayers put the compensating coil upon an auxiliary pole, which thus performed the double duty of a

Fig. 16.



Compensating Windings and Auxiliary Poles.

compensating winding and a commutating tooth. Menges wound the compensating winding in the space between the poles. Ryan furnished the poles with a laminated structure of slotted stampings through which the compensating windings were wound in a distributive manner, with the provision of a special commutating tooth, to serve as auxiliary pole, situated midway between the ordinary poles. All these devices were known, but were scarcely used because at about the time when they were proposed the carbon brush was just coming into use; and as its property of natural commutation by its great simplicity found favour with constructors, its advent was the cause of postponing the introduction of compensating windings and auxiliary poles. With the development however of high-speed machines, motor-generators and turbo-dynamos, employing peripheral speeds so high that ordinary carbon brushes cannot be used, it has been necessary to revert to metal brushes, and consequently to forced commutation, and to devices for compensating the distortion in order to maintain a fixed lead. In this revival of compensating windings Déri has led the way with a distributive coil closely akin to that of Ryan. Parsons has adopted a distributive compensating winding without a special commutating tooth. Brown has adopted Déri's plan with certain modifications. The Oerlikon Company has used a distributive winding depicted at the bottom of Fig. 13; but in its latest machines employs auxiliary poles as described below.

Windings for the purpose of annulling the cross-magnetising (or distorting) effect have sometimes been spoken of as cross-compounding windings. They are compound windings, more or less distributed, but arranged around axes that lie midway between the ordinary poles, and incidentally they *may* be arranged to magnetise a special commutating pole. It is indeed conceivable that a generator might be provided with four separate windings upon its field-magnet structure; (1) the shunt winding to excite magnetisation at no-load; (2) an ordinary compounding series winding to prevent voltage drop—or even to produce a boosting-up of the voltage—at full-load; (3) a cross-compound compensating series winding to annul armature distortion; (4) a series winding upon a special auxiliary pole to serve as a commutating pole.

(*To be continued.*)

INDIAN COTTON MILLS.

With the exception of agriculture itself, the cotton industry is the largest in India, and with that exception, it is the only important one in which the natives themselves have a substantial share. It is represented by a paid-up capital of £11,000,000 sterling, which is largely local or native capital. With an abundance o

cheap labour, raw cotton at her very door, and an enormous home consumption, India enjoys exceptional advantages for the manufacture of cotton goods. With such favourable conditions, she should be one of the greatest cotton spinning and manufacturing nations in the world. Cotton is now almost entirely spun in India by machinery; hand-spinning still survives in certain districts, but it is a decaying industry. The cotton spinning and weaving industry of India is chiefly centred in the Presidency of Bombay, 50 per cent. of the mills being in the city of Bombay itself. Here the first mill in India was built in the early fifties. Twenty-five years later the number had increased to 56, and the spindles to nearly 1,500,000, with 13,000 looms that consumed a quarter of a million of bales of cotton annually. The shortage of the cotton crop, and the resultant high prices that prevailed in the market during the American Civil War, no doubt lent a powerful impetus to the cotton industry of India. At the present time, there are now, in all India, according to the latest returns of the Indian Government, 203 mills, 5,196,000 spindles, 47,000 looms, and 196,369 persons employed. The American Consul at Bombay, in a recent report to his Government, states that he has been informed by an Indian cotton expert, that the mills consume about 50 per cent. of the cotton product of India, and produce 590,000,000 pounds of yarn. Of this quantity of yarn, about 248,000,000 pounds are exported to China and other foreign countries, about 135,000,000 pounds are used in the weaving mills, and about 190,000,000 pounds are used in weaving by hand-loom weavers, the remainder going to the manufacturers of rope and twine. The figures of the production do not, it may be observed, agree with the figures published by the Indian Government, as these show a total production of yarn in 1904-5 of 578,000,000 pounds. Besides the mill-spun yarn there is a quantity of hand-spun, but what the amount really is in all India it is difficult to estimate. However, it is an interesting fact to note, that it is estimated that the amount of yarn absorbed by the hand loom is more than double the quantity used by the power looms. The yarn used by the weaving mills produces about 550,000,000 yards of cloth, of which about 140,000,000 yards are exported to foreign countries, and about 410,000,000 are left for consumption in the country itself. If the production of the hand looms be put down at about 900,000,000 yards, we have about 1,300,000,000 yards as the quantity of "swadeshi," or country cloth, consumed at present in India. There is more or less raw cotton imported each year into India, the quantity depending upon the market price in comparison with the price of Indian cotton. Last year there was imported into Bombay alone, 46,813 bales of American cotton at a value of about £375,000. This cotton was used for mixing with the native cotton, for the purpose of spinning a finer count of yarn, and in weaving a superior grade of cloth than could be produced alone from the short staple variety now grown in India. The spinning of yarn is in a large degree centred in Bombay, the mills of that province producing nearly 76 per cent. of the quantity produced in British India. Bengal produced 7 per cent., the United Provinces of Agra and Oudh about 5 per cent., Madras 5 per cent., and the Central Provinces 4·7 per cent. Elsewhere the production is as yet very limited. A noticeable fact in connection with the production of yarns is the continued increase in the spinning of counts higher than No. 25, which is as much as 46,000,000 pounds, being 8 per cent. of the total production. In Bengal, the United Provinces, and the Punjab, the mills spin hardly any yarn above No. 25, yarn of that count and lower numbers representing 99 per cent. of the whole production. In Bombay, however, the spinning of the higher counts (above 25) is 10 per cent. of the whole, and in Madras 9 per cent., in the Central Provinces it is 5 per cent. Using Egyptian and other imported cotton, the Bombay mills are now spinning in appreciable quantity yarns of No. 40 and upwards. The production of the finer yarns—Nos. 31 to 40—increased last year to about 17,000,000 pounds, from 16,250,000 pounds in 1903-4, and less than 12,500,000 pounds in the two preceding years. Weaving is concentrated in the Bombay mills to an even greater degree than spinning, the mills of that Province producing about 86 per cent. of the whole quantity woven in British India. Madras and the United Provinces produce about 4 per cent. each, and the Central Provinces 5 per cent. of the whole. The goods woven are mainly grey (unbleached) goods, these representing 81 per cent. of the total production. The American Consul says that the conditions and standard of labour in the cotton mills in Bombay are the lowest, at least, in any Asiatic country. In American mills, quality is the unit of measure of production, in India it is quantity. The labour is paid by the piece or pound weight. The wages of the mill agent, and from him down, are based on a pound percentage of the mill production, therefore the tendency is to increase the bulk of the outturn, and another result is that long hours of day labour have been induced. It has been estimated that more than £2,300,000 were made last year as profits by the Bombay mills. The exceptional activity that has prevailed throughout the industry during the last twelve months, the heavy demand in all directions, and the large profits known to have been made, running as high as, in some instances, 40 per cent. in dividends, have quickened every available spindle and loom in India to work to its utmost capacity, and to press labour to its uttermost limits. In 1881, an Act was passed by the Government of India, in the interests of factory hands, one of the chief features being the compulsory closure of all factories for at least four days in a month. This boon was much appreciated by the workmen, owing to the healthy respite afforded to them from their tedious and irksome work. A new factor, however, has been recently introduced in the shape of electric light installations in

the textile factories which has practically nullified the respite. Since the introduction of this light, the mills which formerly used to work from sunrise to sunset, have worked from five in the morning to eight in the evening with the same set of operatives, with only half-an-hour's stoppage in the middle of the day, and as the mill industry of Bombay is at present in a flourishing condition there is a growing tendency among some of the mill-owners to prolong these hours of labour. With regard to the question of cotton growing, the Consul says that it has been ascertained that Indian cotton taken to America from where it is a native to where it is an exotic, will produce a better cotton than in India, tending to a longer and better staple. On the other hand, New Orleans seed planted in India will produce cotton the first year nearly equal to its original, but every year of reproduction from the same seed will exhibit more and more deterioration until the product shall have assimilated to the native Indian cotton. The condition of the two countries, whether of climate, soil, or cultivation, causes the characteristics of cotton to determine in opposite directions. Hence it is believed that a frequent renewal of good staple seeds in India is a necessity. By an analysis made, it is shown that an ordinary crop of cotton removes each year from an acre of soil a little more than $26\frac{1}{2}$ pounds of chemical salts, containing a little more than 9 pounds of potash, nearly 9 pounds of phosphoric acid, a little more than 1 pound of sulphuric acid, $3\frac{1}{2}$ pounds of magnesia, and nearly 2 pounds of lime. Hence it is required that cotton soil should be liberally strengthened by the use of fertilisers rich in phosphates and potash, and having a large amount of sulphuric acid. The native farmer in India does not seem to understand the uses of green manures, and a further appreciation of the use of fertilisers might go a long way in solving the problem of the short-staple cotton. Endeavours to introduce foreign varieties of cotton into India have hitherto proved generally unsuccessful. If, in some exceptional circumstances, they did well at the first sowing, they rapidly deteriorated, and the experiments proved to be failures. In some cases, however, they did not grow at all. So uniform, indeed, had been the failure of efforts to introduce new varieties of cotton, that the attempt had been declared practically hopeless, and hybridization, among indigenous varieties, is thought by many to offer the only prospect of improvement in the crop. An experiment has been undertaken by the Bombay Agricultural Department to grow Egyptian cotton in the Province of Sind. Two years ago Egyptian seed was distributed among selected zemindars to be sown, under the most favourable conditions, closely following Egyptian methods, on a tract of 1,500 acres of land, along the Jamrao canal in the valley of the Indus. The two varieties sown are known by the name of "Abassi" and "Mitaffiffi." Reports claims that, for two seasons, they have proved most satisfactory in both quantity and staple. No signs of deterioration have been observed, and it is further reported that while the local indigenous variety suffered severely from attacks of the bollworm, the imported kinds were almost immune. So far, however, this is but an experiment. Whether the seed will retain its superiority of staple and justify, if only in a measure, all that has been claimed for it, can only be determined after a few successive seasons of trial. It is worthy of note, however, that, notwithstanding the many favourable reports circulated regarding the success of the Egyptian cotton grown in Sind, the official returns show that the outturn of the cotton crop for the past year in that province was below the normal yield.

BETHNAL GREEN MUSEUM.

A large portion of the Asiatic Collection of Lord Curzon of Kedleston is now on view at the Bethnal-green Museum. The collection was made by Lord Curzon in the course of his travels in the East during the last twenty years, and notably during the seven years from 1898 to 1905, when he was Viceroy and Governor-General of India. This collection illustrates chiefly the art of India, Burma, Nepal, and Tibet, but specimens are also included of the art productions of Turkey, Persia, Afghanistan, Siam, and China. It thus embraces, in a single survey, the majority of the countries on the mainland of Asia, and presents a comprehensive picture of some at least of the principal artistic manufactures of the East, as well as many interesting personal mementoes of Lord Curzon's term of office in India.

Upon the right hand, on entering, are a number of objects connected with the celebration of the famous Coronation Durbar at Delhi, on January 1st, 1903, which was presided over by Lord Curzon.

The adjacent cases contain a number of caskets in silver, ivory, wood, and other materials, presented to Lord Curzon by municipalities and other public bodies in India, many of them of purely Oriental design, the remainder showing Western ideas. With these are displayed a number of richly embroidered bags and cases for addresses, *kharitas* (official letters) and ceremonial garlands made of thread of pure gold.

The Indian silverwork also includes a footstool and anklets of Baroda workmanship, and jewellery from the remote hill states in the Himalayas.

In neighbouring cases may be seen two lapis lazuli and silver tables, presented to Lord Curzon by the Amir of Afghanistan, as well as a tall brass candelabrum, of curious pattern, from Kabul; and a large selection of objects purchased by Lord Curzon at the celebrated Art Exhibition at Delhi, in January, 1903. These include specimens of the best Indian wood-carving in tables and screens, inlaid coffers and cabinets from many parts of India, ivory boxes from Vizagapatam, and articles in the various metals and in jade. A separate case is assigned to the carved sandal-wood and the inlaid ivory and rosewood manufactures of Mysore.

Beyond these are the delicate ivory carvings of Murshidabad, in Bengal, representing groups of native life, chessmen, and sacred images. Hard by is a collection of old Indian bronzes, representing figures in the Hindu Pantheon, which were dug up and sold as treasure trove at Coimbatore, in Madras. Jaipur is represented by several beautiful specimens of its costly enamel work upon a background of pure gold.

At the upper end of the Hall, upon either side, may be seen domestic utensils, temple lamps, and furniture, and sacred images, collected by Lord Curzon in Sikkim, Nepal, and Tibet, all of which illustrate a common religion and style. Several of the smaller seated figures of Buddha were presents to the Viceroy from the ruling Lamas at Lhasa and Shigatse in Tibet, and are still clothed in their original silk wrappings of the sacred colours. Here also are a very decorative gilt pole, used as a trumpet-rest at Lhasa, a temple trumpet of prodigious length, a large manuscript with carved wooden covers, a handsome metal helmet, a necklace of human thigh-bones, a drum composed of two skulls, and charm-cases, &c., as used by the Tibetan monks in their priestly incantations.

The collection will remain on view for a considerable period, and will be varied or added to from time to time. It may be commended to those who desire a first-hand acquaintance with the still surviving art productions of the East.

TRADE METHODS IN AUSTRIA.

Most of the commercial travellers in Austria are men who have been at school from eight to ten years, that is to say, from their sixth to their fourteenth or sixteenth year. After leaving school, they enter a retail or wholesale shop, or warehouse, where they have to serve three years as apprentices—generally without salary, later on perhaps they get some pocket money. Lodging, food and clothing have to be provided by their parents or guardians. After three years, the apprentice either becomes a salesman, or is transferred to the stock room. Thence the intelligent youths are taken on as commercial travellers, being sent at first to the neighbouring small villages to visit the country dealers. About £3 a month, and five shillings or seven and sixpence per day for travelling expenses, is the usual payment for the first and second year after apprenticeship. Later, the salary is increased, and higher travelling expenses are allowed. Agents in Austria have to pay taxes, and are therefore considered regular tradesmen, even if they have no open business place or sample room. As a rule, good agents, especially if they have business houses of their own, refuse to represent firms who are not well known, unless they can get contributions and warehouse expenses. They will not run any risks for firms unknown in Austria. Good and reliable agents are, according to the American Consul at Carlsbad, rare in Austria, and as there are many firms who will pay liberal salaries if they can secure their services, American firms, at any rate, find it difficult to obtain them. Many Austrian manufacturing firms have branch houses at Vienna, but there are certain manufacturing firms especially engaged in the making of agricultural machinery which have warehouses and even factories throughout Austria, and when a traveller for instance, leaves a railway station at Prague, he will notice the advertisements of well-known English manfacturing firms who do a large trade in Austria and have their warehouses even in provincial towns. Commercial travellers in Austria are mostly hard-working and respectable men, very temperate in their habits, and extremely diligent. Nearly all of them travel third-class on the railways, and with the exception perhaps of those in the wine and spirit lines, they are seldom addicted to drinking. A traveller who drinks loses the respect of his fellow-travellers in Austria. After having travelled for a few years, these men are considered to be the best and most reliable merchants in Austria when, later on, they establish their own business houses, and even if they do not possess much capital, manufacturers do not hesitate in granting them a moderate credit. In regard to the introduction of British goods into Austria, especially in the machinery, agricultural implements, leather, and many other lines, the following fact should be borne in mind by those firms who wish to introduce their goods into that country. Catalogues, price lists, and even verbal offers in the English language are useless in Austria. The English language is only taught theoretically in the higher schools, and the Austrian manufacturer or merchant does not speak English or even understand it. Persons who understand the technicalities of the ordinary English catalogue are very rare. Agents and travellers are nearly all ignorant of English and therefore unable to comprehend those who speak only that language. The Austrian Government has made it a study for years to discover why Austrian goods are exported in such small quantities to foreign countries, although some neighbouring countries, as for instance Germany, take a very large amount of Austrian goods, and export them to far distant countries. After many year's study and observation, the experts of the Austrian Government have come to the conclusion that the Austrians make the mistake of not visiting the foreign countries personally for the express purpose of studying the language and trade habits in these foreign countries, but confine themselves almost exclusively to sending out catalogues in their own language, which are rarely understood, and to giving the weights, measures, or capacities of their home standards of which scarcely anything is known in foreign countries. An export academy was established at Vienna a few years ago which has already obtained a reputation all over the country. It is well known in Austria that if any person wishes to export goods to foreign countries, he must go to these countries and study their trade methods.

HOME INDUSTRIES.

Metals.—On Monday of last week the price of bar gold touched £3 18s. 1d. per ounce, probably the highest price since the old standard rate of £3 17s. $10\frac{1}{2}$d. per ounce was re-established; and on the same day the value of the August gold output of the Rand was published as £2,080,483, the highest upon record. The price of silver has touched $31\frac{1}{16}$d. per ounce, the highest record for twelve years. Nor is it only in gold and silver that appreciation is to be noted. The rise in price of metals is general, and in most cases prices stand at record quotations. The present quotation of copper is nearly £87 per ton, a higher price than in any year since 1888, when the Secretan speculation pushed it up to £105 per ton. So with tin. Not many weeks ago, it reached the record price of £215 per ton, and now it is quoted at £185 per ton, the highest price on record in any year previous to 1906 being £177 per ton in 1888. Lead again is steadily appreciating in value. The present price of nearly £19 10s. is the highest on record, the nearest approach to it being the £18 per ton reached in 1900. Four years later it had fallen to £10 2s. 6d. per ton. Spelter, again, is now quoted at £27 10s. per ton, and has been £2 higher this year, the highest quotation of the last five years. During the last two or three years the output of iron in the United States and Germany has been enormous in its expansion, yet the present quotation of Scotch iron is 59s. 9d. per ton, a higher price than any reached since 1901, when it was a few pence higher, viz., 60s. These unprecedented prices of metals, taking them all round, are not due to speculation, as with copper in 1888, but to consumption, which has exceeded production. This increase in consumption is attributable not only to the general and large expansion of business, which has been so marked during the last three years, but also to the ever-increasing use of metals in the appliances required by modern civilised life, more especially the various forms of traction and communication. With the constant extension of industrial production there is little likelihood of a lower range of prices for metals. On the contrary, probabilities point to further appreciation until they reach a point which checks consumption.

Cotton Supplies.—Attention has frequently been directed in these notes to the pressing necessity fo extending the cultivation of cotton within the British Empire, so that there will be much less dependence upon the American product. The official figures just published, and bearing upon the American cotton crop of 1905-6, give fresh illustration to this need. It should be remembered that America has not always, or long, been the controller of the world's cotton as she is to-day. Thus in the decades 1870-80, 1880-90, and 1890-1900, America produced $4\frac{1}{2}$, $6\frac{1}{2}$, and $9\frac{1}{2}$ millions of bales, while India produced 2, $2\frac{1}{2}$, and 2 millions; Egypt, 384,000 400,000, and 700,000; and Brazil, 600,000, 300,000, and 380,000 in the same period. Last year the American cotton crop was over $11\frac{1}{4}$ millions, but there has been no similar growth in the production of other countries. More and more America is becoming the controller of the world's cotton supply. The danger of this state of things, as affecting the United Kingdom, was demonstrated during the American Civil War of forty years ago, when the exports of cotton were for a time seriously affected, but forty years ago the United Kingdom took the bulk of American cotton, and the American consumption of cotton was almost *nil.* How completely the position has changed will be seen from the following figures, which are taken from the circular of Messrs. Neill Brothers, and show how the stocks of 1905-6 have been disposed of:—Great Britain, 3,068,000 bales; Continent, 3,952,000 bales; United States (North) and Canada, 2,434,000 bales; United States (South and Burest), 2,388,000 bales. Instead of consuming little or none of her produce, these figures show Americans as disposing of 4,822,000 bales, or more than the whole of the cotton taken by the Continent of Europe, and nearly 2,000,000 bales more than the quantity taken by the United Kingdom; moreover, the American demand is rapidly growing. In 1904-5 America took for herself only 4,482,000 bales of the enormous crop of that year, whilst the foreign exports amounted to to 8,877,000 bales. Experts anticipate that very shortly America will consume at least one-half of her production, and the Continental demand is growing very rapidly. In these circumstances it will be seen how important it is to foster cotton cultivation within the British Empire, and although progress in this direction is much less rapid than it ought to be, thanks largely to the Manchester Cotton Association, and also to the encouragement and help given by the Imperial Government, something is being done to increase cotton cultivation in the Colonies.

The Shipbuilding Output.—In the eight months ended August 31, 1906, the output of the Scotch shipyards was 449,772 tons in 279 vessels, which is no less than 73 vessels and 105,746 tons in excess of the output of the corresponding months of last year. Yet last year was a record one, with an eight months total of 344,026 tons, which had only once previously been exceeded, namely in 1901 with 354,826 tons. Moreover this immense output has been almost entirely of merchant craft, including the *Lusitania* of some 32,000 tons. The Clyde has produced about 416,000 tons of the 449,772 tons total, which included only 10,205 tons for foreign flags. Among the rest were an Anchor line steamer, a Rangoon liner, an Elder Dempster liner, the rest being mostly cargo tramps, dredgers, tugs, &c. This output, immense as it is, would have been much larger if the contracts given out last autumn had been pushed forward. Large orders were then taken for cargo carrying tonnage, but, owing to the great decline in freights, aud the depression in the freight market, many purchasers have, it is said, bargained with the builders to

delay construction, a fact which may explain the delay of which steel makers have complained in obtaining specifications from the shipbuilders for plates they had contracted for. Probably much the same state of affairs exists on the Tyne, Wear, and Tees, so that there must be a large amount of tonnage still on the stocks and to be put into the water before the end of the year. Where cargo is to be found for it all, if tonnage already afloat is to find consignments, is the puzzle. The carrying trade is good, but the supply of new shipping is altogether in excess of its wants, and must remain so until there has been a period of comparative rest from the production of ships.

Improvement in Trade.—An indication of the improvement in trade generally is to be found in the annual report of the Board of Trade on the hours of railway servants. The report covers the year ended July 27th last, and shows that there was a considerable increase in the complaints made to the Department during the year as compared with the preceding year. Thirty-two of these complaints referred to men engaged with trains, and the report remarks:—"It appears that in the autumn of last year, owing to improved trade, there took place on some lines, particularly in the Midland districts, a large and unexpected increase in traffic, leading to congestion in working, with consequent delay to trains and the employment of train men for long hours. It is understood that the companies concerned have been taking measures, by the provision of costly works and in other ways, to mitigate the evil, and that active progress is being made in effecting an improvement."

The Steel Output.—According to returns compiled by the British Iron Trade Association, the total output of open-hearth steel in the United Kingdom in the first half year of 1906 was 2,196,853 tons, which compares as below with the product of the corresponding periods of 1904-5:—

1904. Tons	1905. Tons.	1906. Tons.
1,670,129	1,980,095	2,196,853

The largest production was on the North-East Coast, amounting to 675,409 tons, Scotland taking second place with 652,854—last year the figures were respectively 531,190 tons and 623,585 tons; then South and North Wales 436,877 tons, Sheffield and Leeds 172,896 tons, Staffordshire, Cheshire, &c., 161,636 tons, Lancashire and Cumberland 97,181 tons. The proportion of acid and basic open hearth steel was as follows:—

	Acid. Tons.	Basic. Tons.
North East Coast	510,174	165,235
Scotland	579,447	73,407
Wales	333,291	103,586
Sheffield and Leeds	119,418	53,478
Lancashire and Yorkshire	72,993	24,188
Staffordshire, Lincolnshire and Derbyshire	23,344	133,292
	1,638,667	558,186

The output of plates and angles is much above that of any other description. Next to these leading products come bars (including tin-plate bars) and semi-products such as blooms, billets, &c. The production of plates and bars was 942,751 tons, of bars 493,981 tons, and of blooms, &c., 323,547 tons, a much larger output than in any previous half-year. The production of steel rails was also a record one amounting to 52,458 tons in the six months.

The Crops.—There is an old saying that drought never brought dearth to England and this would seem to be true of the present year. The magnificent weather of the harvest months had a very beneficial effect upon the corn crops. The special report of the *Times*, which it justly claims to be trustworthy, based as it is upon the reports of experienced and eminent agriculturalists residing in every county of Great Britain, concludes that "the aggregate corn harvest of 1906 is a record which cannot be beaten for a long period." The wheat crop is exceptionally good. Wheat loves heat and wants little rain after it is in ear. The wheat harvest of 1905 was 8 per cent. better than the average of the previous ten years, and this year it is better than last. Barley too is good, the crop having greatly improved since the beginning of August. Beans are better than last year and much better than the average of the preceding ten years. Oats are an exceptionally good crop showing a great improvement upon last year. Peas are less good, being quickly affected by dry weather. The potato disease is spreading, Kent and Norfolk being more particularly affected. Root crops have suffered from the drought, but the present rains should help them. Of all the crops, that of hops is the least good. At the beginning of September it was still suffering from the attacks of blight and aphis. The Kent crop will not be more than half an average one, and in all the hop-producing counties it is very poor. On the whole the harvest of 1906 will rank among the best, and it is seldom that the wheat harvest has been better. Unfortunately the area under cultivation was considerably smaller than last year, and some two million acres less than in 1870.

The Underground Railway Companies. — Reference was made in these notes last week to the decision of the directors of the Metropolitan District Railway Company to raise fares, and it was observed that an increase of the kind is of course justifiable if otherwise a line cannot be worked without loss, "but it should be looked to as the last resort, not to be adopted until it is quite certain that working expenses cannot be reduced." This is not the place for controversial matter, but attention may be directed to certain calculations given by a correspondent of the *Times*. Taking the figures of the last half-year he shows that the average number of passengers per train mile run was barely $27\frac{1}{2}$. In 1904, the last complete year before the introduction of electric traction, it was $34\frac{1}{2}$. Or to go back to the first half-year of 1899, the

year selected by Sir George Gibb as a year "when the railway was being worked, without any disturbing elements, by steam power," the average, according to his figures, was nearly 37 per train mile. It follows from these figures that the average loading of the electric trains last half-year was over 20 per cent. less than that of the steam trains of 1904, and it would seem the train mileage run has been greater than necessary. If as many passengers had been carried per train mile last year as in 1904 the gross receipts would have been £50,000 greater, and the deficiency of £49,359 shown by the half year's accounts would not have existed. No doubt the service pays best in which the train service is most frequent and continuous, but this assumes that the public make adequate use of the opportunities offered. Again, if the correspondent is right, on the District Railway the type of car leaves a good deal to be desired from the paying point of view. These cars are about 50 feet long and seat rather less than 50 persons, a train of six seating 290. But a carriage of the same length fitted with ordinary compartments and side doors will hold 80 persons and give them the space and comfort they enjoy on, say, the London and North-Western. A train of six will, therefore, hold about 450 passengers allowing for a guards' compartment at each end, or, if the space per passenger is calculated on the scale of the old third-class carriages of the District Railway, the accommodation could be increased to nearly 600. Then the cost of working these open cars is very heavy. Gatemen or conductors are required between each, and the crew of a train, including the driver, is equal to the number of cars. The steam trains only required four hands and the additional labour for working the electric trains is, according to Sir George Gibb, costing £20,000 a year.

GENERAL NOTES.

Prices of Nitrogen Units.—An analysis is given in the *Journal des Usines à Gaz* of the respective values of the unit of nitrogen in ammonium sulphate, calcium cyanamide, and calcium nitrate to show the possibilities of the competition likely to arise from the conflict between the sulphate of ammonia derived from gas, the Chile nitrates, and the new compounds of nitrogen obtained by means of electric action. The total annual production of nitrates from Chile, with an average of 16·5 per cent. of nitrogen, may reach 1,567,000 tons, each kilogram of nitrogen in which is valued at 15½d. The estimated amount of ammonium sulphate produced annually by the chemical industries varies from 500,000 to 600,000 tons, and the kilogram of nitrogen in this salt is set down at 14½d., taking 21·2 per cent. of nitrogen throughout. In calcium cyanamide the value of the nitrogen may range from 13½ to 15½ per kilogram, while in calcium nitrate, under certain conditions, the kilogram of nitrogen may be produced at 12½d. Of course, the relative cheapness of the new nitrogen products will depend entirely upon the use of electricity generated by water power at very low rates.

Damascus.—Whilst the railway is slowly creeping towards Damascus—at the close of 1905 it had reached Mudevera, and is now half-way towards Tebuk—its first electrical enterprise has begun. A concession has been obtained by a Belgian company and its terms comprise a monopoly of electric traction, light and power, a virtual monopoly of electrical appliances, a right to establish agencies elsewhere, and a telephonic service should such be necessary. The company is under contract with the municipality to light certain parts of the town, and is bound to repair the streets where the tramway passes. A force of 1,200 horse-power is derived from the falls of the River Barada at El Tekîye, 22 miles from Damascus. The original plan was for five miles of tramway, crossing the city in two directions. For the present about 3½ miles, connecting the suburbs of Meidan and Sahhîyeh, are being built. The bulk of the work of harnessing the falls is now finished, in the town rails are laid on half of the 3½ miles, and the transforming station, depots, &c., are nearly completed.

Morocco.—Mr. Consul Maclean (Cd. 2682) is of the opinion that "the Algeciras Conference has unlocked the doors of Morocco to enterprise and has made it clear that all future works are to be tendered for in the open market, and a State bank is to be established which will watch over the administration of finances. There is to be no favouritism, and it follows that contracts will go to those people who have gone to the expense and trouble of making themselves thoroughly acquainted with the labour, character, climate, and other conditions of Morocco." French and German engineers are constantly travelling through the country which wants "roads, bridges, telegraphs, railways and canals," but Englishmen are less active in discovering the chances of doing business. Nor is the United Kingdom holding its own in the export and import returns. In 1896 the total trade of Great Britain in Dar-al-Baida was 46·89 per cent., in 1905 only 35·19, France having in the same period increased her percentage from 23·12 to 33·25, and Germany from 14·17 to 18·12. Meantime, to quote Mr. Consul Maclean "there is nothing new to be said of the methods of agriculture. The pre-Islamic type of plough yoked to cows, bulls, horses, donkeys, camels, or women, continues to lightly harrow the fertile soil; when a stone is met it is gently put on one side, there is no need for hurry or serious exertion; the sower follows the plougher or ploughwoman, and sows the seed for the wind to scatter. When the seed is in the ground the peasant sits down and waits for rain. A plentiful rainfall produces a wonderful crop, but a drought drives the women to dig for wild arrowroot for food for their husbands and children, and many of the people die from starvation."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The Programme for 1907 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. (post free 4d.). Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The Examinations are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The Commercial subjects include:—Bookkeeping, Accounting and Banking, Shorthand, Type-writing, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages.

The Examinations will commence on Monday, April 15, 1907.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted in each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates will be given; in Harmony Higher, Intermediate, and Elementary Certificates.

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments of Music are the same as for Stages II. and III.

Medals and Prizes are offered in each subject in Stages II. and III. Full particulars will be found in the Programme.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

PROCEEDINGS OF THE SOCIETY.

HOWARD LECTURES.

HIGH-SPEED ELECTRIC MACHINERY,

WITH SPECIAL REFERENCE TO

STEAM-TURBINE MACHINES.

By Professor Silvanus P. Thompson, D.Sc., F.R.S.

Lecture II.—Delivered January 25th, 1906.

(Continued from p. 1022.)

Turbo-Dynamos.

Because of the high speeds with which steam turbines run, it is impossible to avoid high peripheral speeds for the commutators. It has been generally considered hitherto that 3,000 feet per minute is the highest speed at which a commutator will give satisfaction with carbon brushes. But if the turbine runs at 3,000 R.P.M., and the commutator is only 10 inches in diameter, the surface-speed is already 7,854 feet per minute. Moreover, at these high speeds, centrifugal forces become enormous, so that special means must be adopted for securing the conductors of the armature winding, and the segments of the commutator, from flying out. The former are usually secured by end caps of bronze, or by

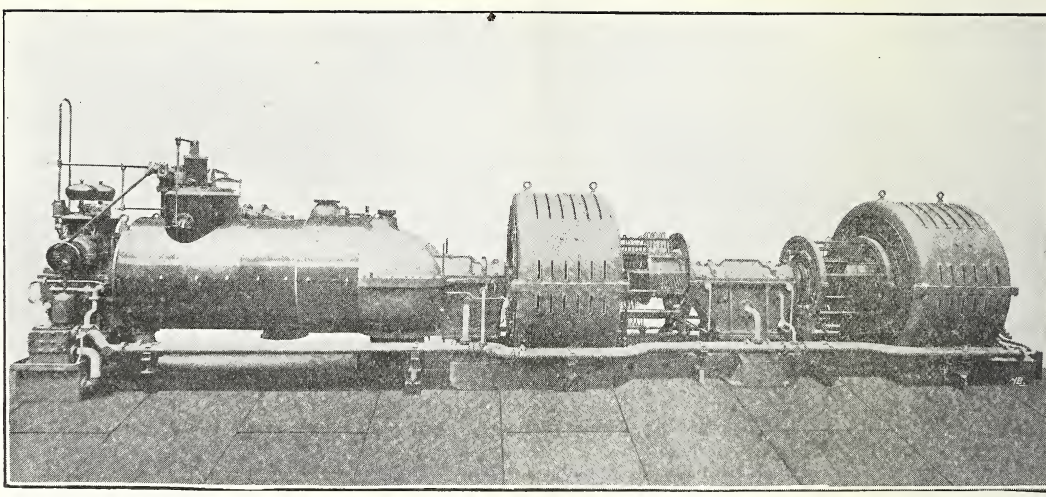
very heavy belts of binding wires. The segments of the commutator are held together by solid rings of self-hardening steel shrunk on over insulating rings of mica. The commutator is kept as small in diameter as possible; but as the segments cannot well be reduced in breadth below 0·25 inch at the surface, and as they usually number about 60 in 2-pole machines, or from 100 to 120 in 4-pole machines, the diameters usually run from 9 to 12 inches. Further, in order to obtain sufficient contact surface for the brushes, the commutator must be made very long in proportion. Two shrunk-on steel rings, one at each end of the segment, and each of say three square inches of cross-section are not even sufficient for such commutators: and it is usual to find an additional ring, or in some cases two additional rings, shrunk on at intermediate places. A commutator, 18 or 20 inches long, and 10 inches in diameter, will have four such rings to hold it from flying apart.

Mr. Parsons so far back as 1885 began to construct turbo-dynamos of small size, and has more recently designed a number of larger sets. At Derby the Parsons' turbo-dynamos of 300 kw. run at 3,000 R.P.M., and work at 500 to 550 volts. For the Newcastle and District Supply Messrs. Parsons and Co. have furnished machines of 1,000 kw. at 1,800 R.P.M., working at 530 volts. These are 4-pole machines. For the Manchester Corporation they have supplied machines of 1,800 kw, working at 460 volts. Each turbine drives two dynamos built on the same shaft, as shown in Fig. 17. The reason for this practice, which is adopted by most of the makers of large units, is that, owing to the commutation difficulty, it has not been found expedient to construct the dynamos themselves of higher output than from 500 to 900 kw.

Messrs. Parsons have used metal brushes of stiff brass wire enclosed in gauze covers, pressed against the commutator by weights. To secure a better bedding of the brushes they at one time formed the commutators with corrugated outline, the brushes lying in circular depressions turned in the periphery. In their earlier types they devised a most ingenious mechanism to rock the brushes forward automatically by steam pressure according to the load on the machine. More recently they have adopted a compensating winding without any special commutating tooth (Patent No. 12,408 of 1903); and with the adoption of this plan it has been found possible to fix the brushes once for all.

Messrs. Brown, Boveri, and Co., who have taken up the Parsons' patents on the Continent, have made many turbine sets, from compact ship-lighting sets of 65 kilowatts for the German navy up to large plant of 2,700 horse-power, like that furnished to the tramways at Liège. Fig. 18 shows the field-magnets of a 4-pole 125 kw. dynamo, for driving at 3,000 R.P.M. In this figure the carcase is shown

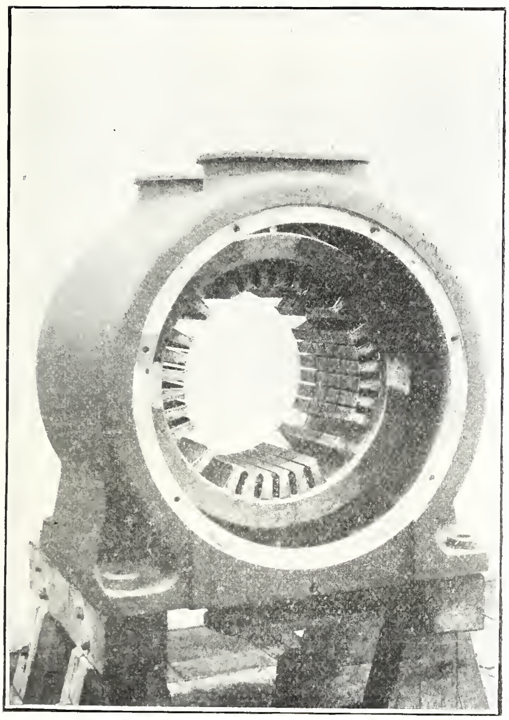
Fig. 17.



Parsons' Turbine of 1,800 kw., driving two Dynamos.

unwound. It will be seen that each of the 4 poles is slotted with 5 slots. Of these the centre one is left empty, while the other four receive the compensating windings. Between the four poles are four narrow projecting teeth which serve as auxiliary commutating poles. The wide slots on each side of the tooth are to receive the shunt winding. It will be noted how the frame is arranged with a view to ventilation with air channels that lead up into

FIG. 18.

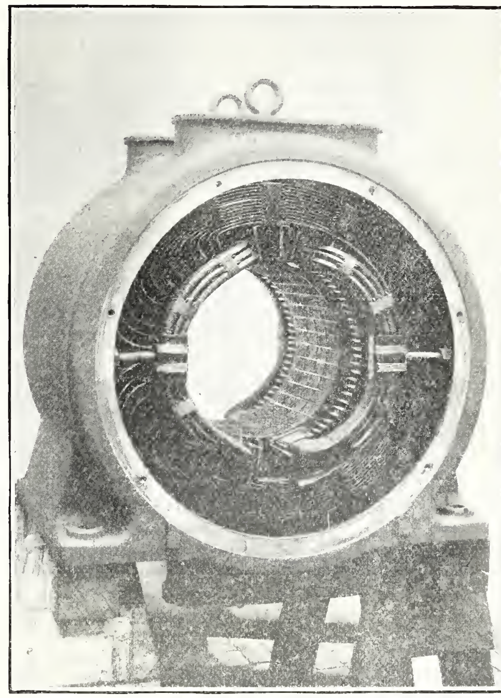


CARCASE OF BROWN'S TURBO-DYNAMO.

the two short chimneys at the top. Fig 19 depicts a similar carcase for a 2-pole machine of the same size. The principal poles, right and left, have each 12 slots to receive a distributed compensating winding. There is a commutating tooth at the top and at the bottom. The shunt windings fill the wider slots; and means for anchoring the end-bends are afforded by steel bolts, which project at the sides. It is impossible to do justice in the compass of a short notice to the varied machines which Messrs. Brown, Boveri and Co. have designed. Fig. 20 depicts the armature of a 1,500 kw. dynamo supplied to the Rheinisch-Westfälisches Elektricitätswerk at Essen. It runs at 1,000 R.P.M., and works at 600 volts. From July, 1903, to September, 1905, this firm constructed turbo-generators having a total output of 25,000 horse-power.

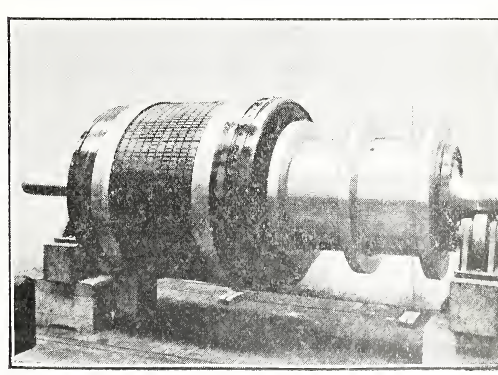
The Siemens-Schuckert works of Berlin have adopted the Zoelly turbine, and construct

FIG. 19.



FIELD-MAGNETS OF BROWN'S TURBO-DYNAMO.

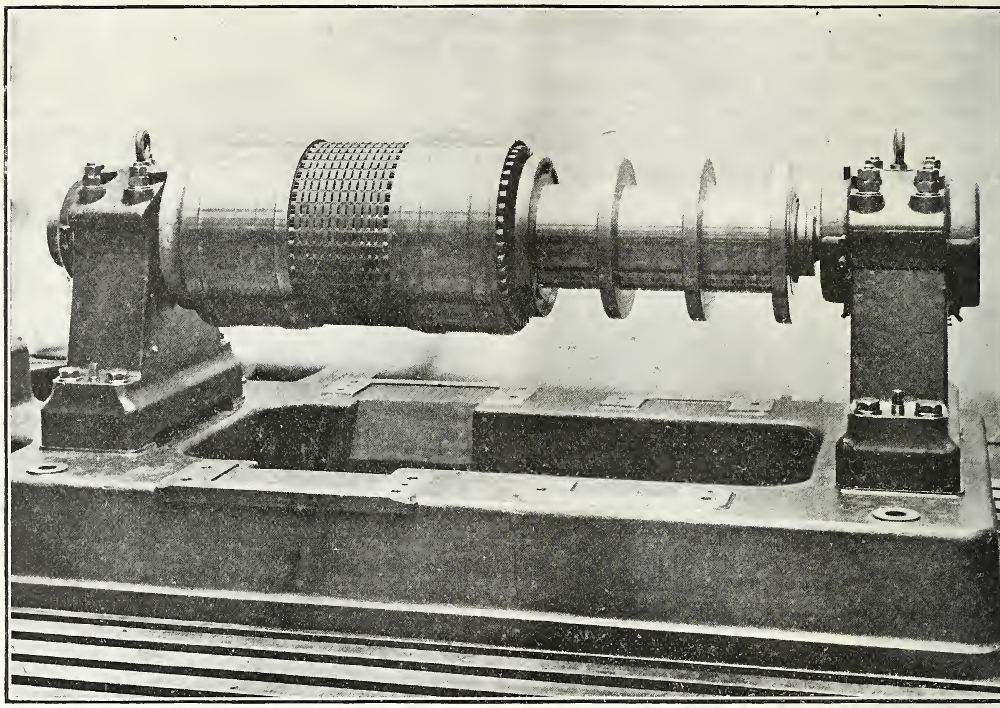
FIG. 20.



ARMATURE OF BROWN'S TURBO-DYNAMO.

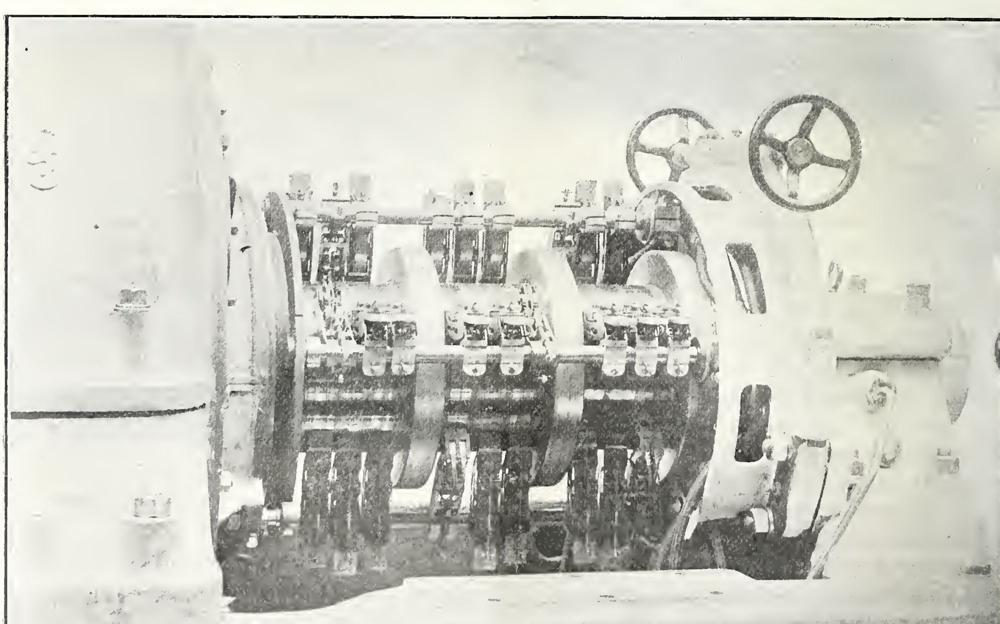
turbo-dynamos in numerous types from 35 kw. at 4,000 R.P.M. to 1,600 kw. at 1,000 R.P.M. Fig. 21 shows the armature of a 170 kw. 220 volt machine for 3,000 R.P.M. It will be seen that the end-bends of the windings are

FIG. 21.



ARMATURE OF SIEMENS-SCHUKERT TURBO-DYNAMO.

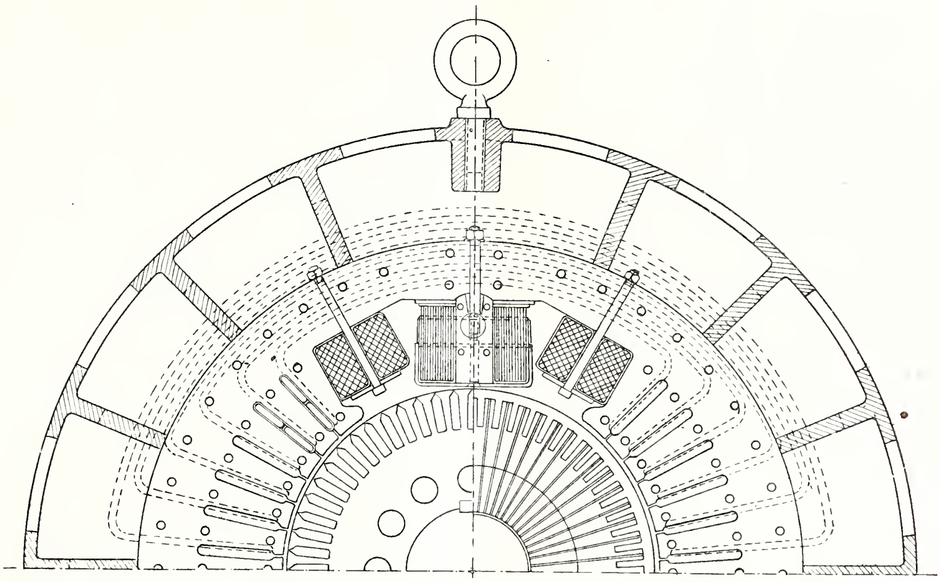
FIG. 22.



BRUSH-GEAR OF SIEMENS-SCHUKERT TURBO-DYNAMO.

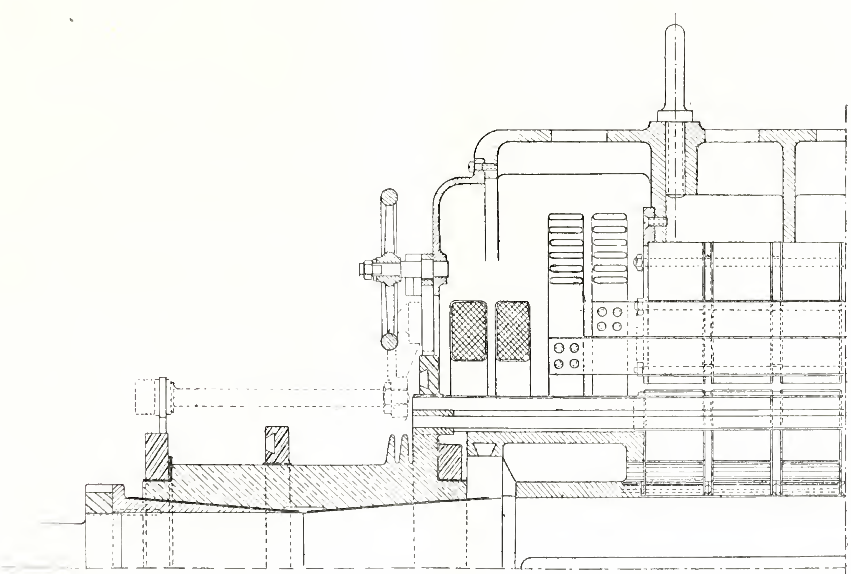
covered by metal casings, which, in the latest machines cover the risers also at the anterior end so as to prevent copper dust from the commutator from penetrating into the interior. in Fig. 22, in which it appears that some carbon brushes are used along with metal ones. According to researches made by the Siemens-Schuckert works, carbon brushes can

FIG. 23.



OERLIKON TURBO-DYNAMO, WITH AUXILIARY POLES AND COMPENSATING COILS. SCALE 1 : 10.

FIG. 24.



OERLIKON TURBO-DYNAMO (LONGITUDINAL SECTION).

The commutator has four shrunk-on rings. In the latest machines these are insulated at the flanks to prevent flashes of sparks along them. The brush-gear for a 4-pole, 250 volt turbo-dynamo of 340 kw. at 3,000 R.P.M., is shown be used up to 6,000 feet per minute. All their continuous-current turbo-dynamos are provided with auxiliary poles. Ventilating housings are used for all machines.

Messrs. Siemens Brothers and Co. of London

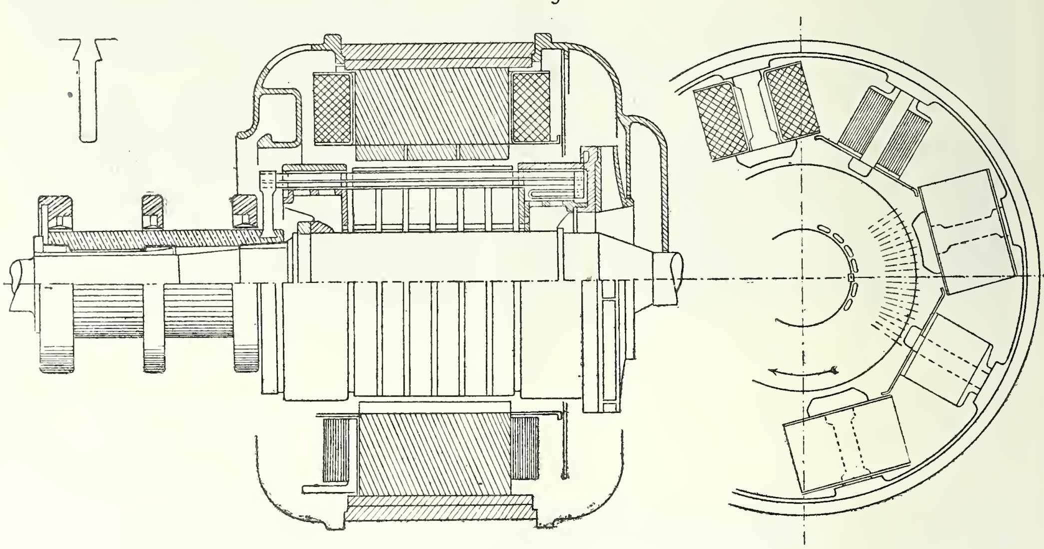
and Stafford have also entered upon the manufacture of dynamos, using chiefly turbines of the Willans-Parsons type. For example, they have supplied to Shoreditch four Siemens-Willans sets of 750 kw. at 550 volts, running at 1,500 R.P.M., and others to the Corporation stations at Glasgow and at Manchester.

The Allgemeine Elektricitäts Gesellschaft of Berlin, has established an extensive factory for turbo-generators, and has supplied a large number of small units of 45 kw. and 75 kw. for service in the German navy. The turbines are of the Riedler-Stumpf variety. The speeds vary from 4,000 R.P.M. for 12 kw.; to 3,000 R.P.M. for 100 kw.; and to 1,500 R.P.M. for 500 kw. A very full account of these machines is given in *Engineering* of August 19th, 1904.

The Brush Electrical Engineering Company manufactures turbo-dynamos under licence from the Parsons Company. Its machines have a compensating winding to neutralize distortion, and another winding on auxiliary commutating poles. They use wire gauze brushes pressed against the commutator by balanced counter-weights. The brush gear is mounted independently of the bearings; and the position of the brushes when once adjusted remains fixed, so that no rocking gear is required. The armature conductors are laid in slots and secured by steep wedges. There are no binding wires, the end connectors being covered by manganese bronze gaps.

The Oerlikon Machine Works of Zürich have developed steam-turbine machines of many types. Of those for continuous-current supply two examples may be cited. Figs. 23 and 24 depict a 150 kw. bipolar dynamo, for 3,000 R.P.M., designed two years ago, to give 650 amperes at 230-250 volts. The diameter of the armature core is 17·8 inches, the core-length 19·7 inches, the width of air-gap 0·296 inch. The armature has 60 slots with two conductors per slot, and the number of commutator segments is 60. The diameter of the commutator is 10·4 inches, the gross length of the segments about 16 inches, and the available working length between the shrunk-on rings about 8 inches. The peripheral speed of the armature is 14,000 feet per minute; that of the commutator 8,100 feet per minute. The specific loading is 700 amperes per inch. As Fig. 23 shows, there is a distributive compensating winding as well as auxiliary poles.

Fig. 25.

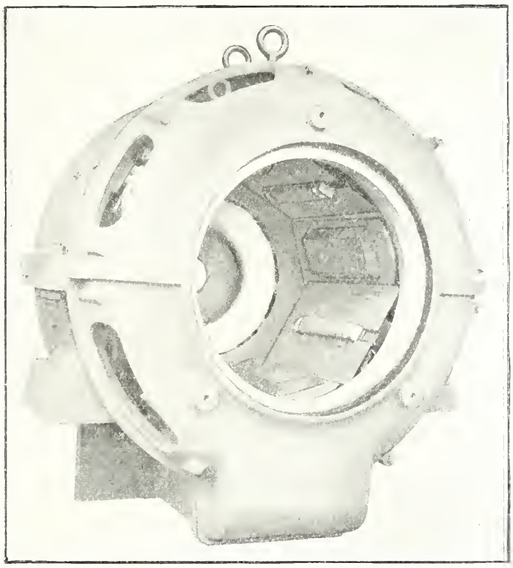


Oerlikon 4-Pole Turbo-Dynamo with Auxiliary Poles.

Fig. 25 is a scale drawing of a quite recent turbo-dynamo of the same firm, a 4-pole machine of 200 kw. at 3,000 R.P.M., to give 800 amperes at 250 volts. The armature diameter is 22·02 inches; the core length 17 inches. It has 100 slots, with two conductors in each slot. The air-gap is 0·590 inch. The commutator diameter is 10·25 inches; its gross length 22·5 inches. The armature is lap-wound, with equalising connectors. As will be seen from the drawing there is no compensating winding, magnetic distortion being minimised by making the pole-arc small, and by reducing the cross section of the pole-cores so as to obtain high saturation. There are

four auxiliary poles for commutation, and these are each excited by an auxiliary winding of 11 turns of copper strip, 6 inches wide and 0·136 inch thick. Fig. 26 is a photograph of the field-magnet carcase of this machine. It shows

Fig. 26.



Field-Magnets of Oerlikon Turbo-Dynamo.

the pole-faces, and indicates the provision made for securing adequate ventilation of the parts. Fig. 27 is the armature of this machine as constructed, with the windings in position, but before the application of the bronze cups over the end-bends of the windings.

The British Westinghouse Company has supplied to the Savoy Hotel four turbo-dynamos, each of 4-pole design. They have slots in the pole-pieces, to secure uniformity of distribution of flux at the face, and so reduce the no-load losses to a minimum.

The General Electric Company, of Schenectady, using the Curtis vertical turbine, has constructed some 200 continuous-current sets from $1\frac{1}{4}$ kw. up to 800 kw., the majority being from 15 to 25 kw. One of 500 kw. is in use in the power-house of the British Thomson-Houston Company at Rugby, and another in Cork for the Cork Tramways and Lighting Company.

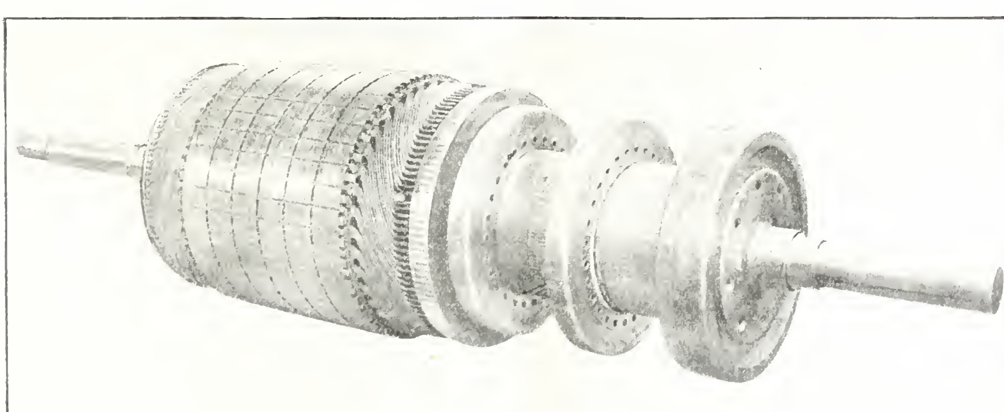
Comparison of Turbo-Dynamos with Slow-speed Dynamos.—The Oerlikon turbo-dynamo just described, of 200 kw. at 3,000 R.P.M., is here compared with a 6-pole dynamo of 200 kw. at 135 R.P.M., being a machine described on p. 190 of Parshall and Hobarts' "Electric Generators." The machines differ in that the high-speed machine is for 250 volts, while the low-speed machine is for 500 volts.

Machine A (Oerlikon) M.P.T. 4 – 200 – 3,000
Machine B (Parshall) M.P. 6 – 200 – 135

The dimensions are in inch units.

	A	B
Diameter armature core	22·02	59·25
Length (gross) armature core	17	14·25
Number of air-ducts	5	5
Nett length of iron in core ..	14·3	9·9
Number of slots in armature..	100	220
Conductors per slot	2	8
Total number of conductors..	200	1,760

Fig. 27.



Armature of Oerlikon Turbo-Dynamo.

Width of air-gap	0·590	..	0·33
Outside diameter of yoke	45·7	..	112·5
Equivalent pole-span	7·1	..	23·1
Pole-pitch	17·325	..	31·2
Diameter of commutator	10.25	..	39
Length, gross, of commutator	22·5	..	9
Working length of commutator	13·4	..	6·75
Number of segments	100	..	400
Width of segment at face	0·322	..	0·240

Calculated Data and Co-Efficients.

Steinmetz co-efficient	1·87	..	4·2
Esson co-efficient	124,000	..	35,000
Peripheral speed (feet per min.)	17,300	..	2,100
Amperes per inch periphery	576	..	616
Flux per pole	2,500,000	..	13,300,000
Flux-density in gap	20,600	..	45,000
Pole span ÷ pole pitch	0·46	..	0·74
Commutator diam. ÷ armature diameter	0·48	..	0·66
Peripheral speed of commutator	8,350	..	1,400
Centrifugal force at armature surface (pounds per lb.)	1,406	..	8·6
Centrifugal force at commutator	640	..	5·8
Stiffness ratio	125	..	49
Commutation figure of merit j	2·81	..	2·92

A further comparison is afforded by three machines of 250 kw., having speeds of 3,000, 250, and 125 R.P.M. respectively. These are:

Machine C (Brown Boveri)	Bip.	—	250 —	3,000
Machine D (Hobart)	MP.	8—	250 —	250
Machine E (Kolben)	MP.	10—	250 —	125

Of these machines, C is designed for 450 to 650 volts, D for 250 volts, and E for 550 volts.

Ventilation and Temperature-Rise.—Little has been said above as to the question of temperature-rise, for as a matter of fact in continuous-current machines the limit of output, if ordinary regard has been paid to ventilation, is set not by the temperature-rise but by the commutation question. If one draws too much current from a machine (always supposing the engine still to apply the increased power at the given speed) one of several things *might* happen: (i) overheating; (ii) mechanical harm, such as shifting of conductors; (iii) sparking at the commutator. The second of these never occurs with modern machines with slotted armature cores. The first is obviated by proper design of ventilating ducts; and in high speed machines is easier to control than in low speed machines. So that for turbo-dynamos the designer's attention is concentrated on the commutation problem already dealt with.

IMPROVEMENTS IN CARBON BRUSHES.

So much of this lecture has been devoted to the part played in natural commutation by the carbon brush that the importance of the matter is apparent. The difficulty of applying carbon brushes to turbo-dynamos lies in the high surface speeds of the commutators. Ordinary carbons on such commutators are not satisfactory, because if used with ordinary pressures (such as 1·5 to 2 lbs. per square inch) they are apt to chatter if there is the slightest inequality of periphery. However light they are made, their inertia does not permit them at speeds of 2,000 or 3,000 revolutions per minute to follow the inequality of surface. And if, to prevent chattering, higher pressures are applied, then there is further trouble, for a soft carbon will smear the commutator, and a hard carbon

	C		D		E
Number of poles	2	..	8	..	10
Steinmetz co-efficient	1·55	..	1·79	..	4·35
Esson co-efficient	88,000	..	21,500	..	34,900
Peripheral speed (feet per minute)	14,800	..	3,100	..	2,200
Pole-pitch	29·6	..	18·6	..	20·6
Pole-arc ÷ pole-pitch	0·57	..	0·7	..	0·76
Amperes per inch periphery	680	..	770	..	475
Flux per pole (megalines)	15·1	..	5·35	..	15·1
Flux-density (mean) in gap	54,800	..	45,000	..	58,000
Flux-density (apparent) in teeth	144,000	..	134,000	..	89,800
Current in one conductor	272	..	125	..	114
Watts per cubic inch of active belt	142	..	98	..	74
Peripheral speed of commutator	8,000	..	2,360	..	1,310
Integral electric loading	40,256	..	114,576	..	97,150
Integral magnetic loading	$30{\cdot}2 \times 10^6$	..	$43{\cdot}1 \times 10^6$	..	151×10^6
Commutation figure of merit	5·6	..	—	..	—

will score it into ridges, and in either case there will be excessive heating. Messrs. Parsons state that they have never found carbon brushes satisfactory except on one small and slow-speed machine. Messrs. Siemens-Schuckert, on the other hand, use mixed arrangements, of a few carbon brushes along with a majority of metal brushes.

Recently, however, the carbon manufacturers have bestirred themselves to produce special qualities of carbon brush suitable for use with high speeds. Foremost amongst these is the Morgan Crucible Company, of Battersea, who have introduced in their manufacture several novel features. In the first place, all their brushes are made with an invisible grain in the longitudinal direction, which results in their having a low conductivity laterally, and a much higher conductivity longitudinally. This feature of stratification tends to reduce parasitic currents within the brush and to lessen the heating. The friction co-efficient is also low. Another type, known as "link-two" carbon, has the peculiarity that the longitudinal resistance is higher at one side than at the other, and of intermediate values between. Hence such brushes are of particular value for machines running in one direction only, the edge of higher resistance being the edge where the last contact is made; for if the carbon at the toe of the brush is of higher resistance, then, as is easily seen by reference to Fig. 13*d*, the presence of a higher resistance at this part will tend to diminish the current that is dying out, while the lower resistance at the heel will tend to augment the current that is increasing, so helping the completion of the process of commutation. The reduction of resistance in one side of the brush is facilitated by the introduction into the carbon, during manufacture, of finely divided copper. Another type of Morganite brush, known as "link-four," has high conductivity at the middle and low conductivity at both sides. It is intended for use with reversing motors, but has no importance for turbo-dynamos. Messrs. Morgan have had Morganite brushes for some months upon a Parsons' bipolar turbo-dynamo at their works. This is a 90 kw. machine designed seven years ago, giving 650 ampères at 115 volts, running at 3,530 R.P.M. The commutator, which is 8 inches in diameter, and has only 30 segments, is 10 inches in useful length. It was designed for metal brushes, the peripheral speed being 7068 feet per minute. To this machine Messrs. Morgan adapted their special carbon brushes, with a pneumatic brush holder that keeps the brushes in contact with a minimum of inertia. The machine had no compensating winding, and was not intended to be used with the brushes in any fixed position. In fact, with metal brushes it was necessary at full load to give the brushes a lead some three inches in advance of their position at no-load. But with the carbon brushes sparkless commutation was obtained with a fixed position of brushes between $\frac{1}{4}$-load and an overload of 5 per cent. Morganite brushes are also used in ordinary holders, on turbo-dynamos, by Messrs. Siemens Brothers, at Manchester, and Glasgow; and Messrs. Brown, Boveri and Company are also using them on their turbo-generators, such brushes being set on the brush-pillar in front of a gauze brush.

Further experience is of course necessary with these brushes to ascertain whether they possess the necessary mechanical qualities to last for long periods.

Homopolar Dynamos.

There is yet one other way of getting over the commutation difficulty; and that is to have no commutation at all. Ever since Faraday's primitive disk-dynamo of 1831, the designers of electric machines have been haunted by the possibility of constructing a machine of the so-called "Unipolar," or rather *homopolar* type, with sliding contacts and no commutator. Many such machines have been designed. Several successful ones are described in the author's treatise on "Dynamo-Electric Machinery," including one by Brown, and a more recent one by Rankine Kennedy. The peculiarity of such machines, if made for ordinary speeds, is their very low voltage, which renders them useless for any but electrolytic services. This excessively low voltage—from 2 to 10 volts—is an inherent fault of low speed. But with the advent of steam-turbines, and the possibility of rising enormous surface speeds, the old difficulty seems likely to disappear. It is possible now for a moving conductor to generate 1 volt per inch of its length, instead of requiring as was formerly the case some 6 or 7 inches per volt. The following calculation proves the point. Let a conductor move at a speed of 10,000 feet per minute through a magnetic field having a flux density of 50,000 lines per square inch. 10,000 feet per minute is 2,000 inches per second. Hence each inch length of the conductor will cut $50{,}000 \times 2{,}000 = 100{,}000{,}000$ lines per second; that is it will generate 1 volt. So unless

unforeseen difficulties should arise in collecting the current from a sliding surface at such speeds, machines on this plan will be entirely practical.

In fact, two of the leading firms have constructed homopolar dynamos, the General Electric Company of Shenectady from the designs of Mr. Noeggerath ; the British Westinghouse Company from the designs of Mr. Miles Walker. Mr. Noeggerath's machine, known as an acyclic generator, is of 300 kw., working at 500 volts, driven by a Curtis turbine of vertical pattern. The revolving cylinder is built up of 24 smooth conductors, held by steel binding wires, each conductor terminating in a steel slip-ring ; and connection is made from the slip-rings at one end to those at the other by means of copper brushes, so that all the conductors are united in series. Experiments have shown that the contact voltage developed at each contact increases with the current density. As might be expected, this voltage, when the surfaces are stationary, is nearly proportional to the density ; and it amounts to less than 0·4 volt for a current density of 1,000 amperes per square inch. When running at a surface speed of 10,000 feet per minute, the contact voltage rises with the current density from about 0·2 volt when the density is small to about 0·8 volt for a density of 1,000 amperes per square inch. At speeds above 7,500 feet per minute, with copper brushes on steel collecting rings, the losses became nearly constant, and the temperature went down. All this is most satisfactory, as it demonstrates the entire practicability of this type of machine.

The homopolar dynamo, designed by Mr. Miles Walker, is built as an exciter for a turbo-alternator, and consists practically in an iron cylinder revolving in a uniform radial field. It generates current at 10 volts only; the current being passed along the shaft to the circuits of the field-magnet of the alternator. Extreme solidity and simplicity characterise this machine. Its field-magnets are separately excited. It is at present impossible to foresee to what fresh developments these important departures may lead.

THE AGRICULTURE INDUSTRY AND COMMERCE OF JAPAN.

The issue of the Financial and Economic Annual of Japan, 1906 (prepared by the Department of Finance, Tokyo), deals with many subjects, such as external indebtedness, imperial and local taxation and expenditure, internal production and external trade. Such a field is too varied for treatment in abstract in these pages, but space can be accorded to some notes and figures indicating the present industrial conditions of our allies during the latest year for which information is available, and a comparison may be made of the conditions then ruling with those of earlier years.

Agriculture is the greatest of all Japanese industries, affording occupation to more than 60 per cent. of the population. Alive to the fact that Japan is behindhand in the application of scientific principles to agriculture, the State has fostered it, and directed improvements in a singularly sweeping and far-sighted manner. Roads and waterways used for agricultural purposes have been rearranged and straightened, the use of machinery promoted, and preventive measures taken to prevent damage by floods. Agricultural co-operative societies have been encouraged, and the supply of capital for agricultural purposes facilitated by the establishment of banks. State experimental farms have been established for the purpose of investigating seeds, diseases and insect pests, and for improving the breeding of stock. In order to improve the silk industries, institutes have been established for the training of experts in silkworm rearing and filature. A raw silk conditioning house has been established in Yokohama, where strict examination of the product takes place in order to give security to traders in raw silk. As a result, the output and quality of the silk produced are continuously increasing. With regard to tea, experiments are conducted at the state farms in the rearing of tea plants, and in the improvement of tea-manufacturing machinery. The result has been a reduction in manual labour, diminution in the cost of production, and improvement in quality. Stringent laws for the removal and prevention of diseases and noxious insects are rigidly enforced.

Rice.—The area devoted to the cultivation of rice has remained fairly constant during the past ten years, the yearly fluctuations not exceeding four per cent.; the area under cultivation is 1904 being 7,057,751 acres. While the area has not increased, larger yields have been secured, the amount harvested in 1904 of upwards of 252,000,000 bushels constituting a record.

Barley and Wheat have not increased in regard to either the area or yield of crops, the area in 1904 being 4,415,000 acres, and the combined yield being 96,250,000 bushels.

Other Crops.—Particulars are given of twelve other crops such as millet, beans, rape seed, &c. The yield of potatoes has nearly doubled, of hemp fallen by one-fifth, of seed cotton fallen by nearly three-fourths, and indigo to nearly one-half. As regards tea, the production of green tea is fairly steady, while that of black and Oolong tea has fallen almost to the point of disappearance. The production of lacquer has increased since 1895 by 25 per cent. to 415,710 lbs. weight.

Silk.—Very complete enumerations are carried out

of the number of egg-cards hatched, the yield of cocoons at each season, number of factories and families occupied in the industry. The total yield of silk in 1904 was 22,060,000 lbs.

Fishing also is an old-established occupation, the native fishermen having long carried on their industry in open boats. Such skill was manifested by the fishermen, and so large were the catches that a fishery law was promulgated in 1901, in which to protect fish breeding, the use of certain gear and methods were interdicted and close seasons established. With the decked vessels in recent use fishing has been carried on in Korean and Russian waters, and even as far south as the Philippines; sealing schooners and whaling vessels are increasing in numbers and size. The culture of marine products is systematically undertaken, seaweeds and oysters having received attention from very early times. Recently the breeding of pearl oysters and gathering pearls therefrom has been set on foot and has given highly satisfactory results. Freshwater culture is applied to carp, snapping turtle, and eels. Fishery associations and marine products associations have been organised. The object of the former is to deal with rights to fishing areas and the maintenance of fishing villages; the latter deal with the improvement of tackle and methods, arbitrate in regard to disputes, and deal with commercial matters generally. With the object of imparting technical knowledge relating to the marine industries, the Government has established a fisheries institute where special theoretical and practical instruction is given. Various experimental researches are carried out under its auspices. Experts are also sent out on lecturing tours: fish fry and seed shell-fish are distributed, and practical instruction is given to the fishermen's children in the catching, manufacture, and culture of fish.

The value of the raw products, *i.e.* fresh fish, has increased from 23,726,306 yen* in 1895 to 42,632,633 yen in 1904, among the products being sardines, bonito, mackerel, prawns, cuttle fish, herring, and a variety of tunny. The value of manufactured products, dried fish, guano, and manure has similarly increased, from 20,801,339 yen to 31,726,659 yen.

The evaporation of brine for salt has been actively carried out, the value in 1904 being 9,971,327 yen.

Mining, which was previously in a very backward state, has now become an important industry. In its early development the Government owned several mines, which were worked according to the most recent European methods. These mostly proved to be costly financial failures, so, to avoid further losses, a majority of them were after a time sold to private persons, in whose hands they have prospered and brought about a general development of the industry.

Coal mining affords an occupation for 88,330 persons, metalliferous mining for 69,133 persons, and non-metalliferous mines for 7,395 persons. The value of the chief products in 1904 was, gold 3,680,685 yen, silver 2,276,905 yen, copper 17,979,255 yen, iron 1,413,432 yen, antimony 83,744 yen, manganese 36,039 yen, coal 29,218,134 yen, petroleum 2,776,433 yen, sulphur 571,444 yen, and graphite 37,088 yen.

* The Yen = 2 shillings.

Factories.—The tables of statistics relating to factories are particularly well arranged. In 1904 there were 9,234 factories, employing 207,591 male and 318,264 female *employés*. Of these factories 2,848 were driven by steam engines, amounting in numbers to 5,450, and in aggregate horse-power to 168,919; 849 factories were worked by water-power alone, the aggregate horse-power being 5,801. Steam and water-power, gas, oil, electricity, gas and steam, and electricity and steam are variously used. So far are the detailed returns carried, that each factory is interrogated, and the answers grouped under forty headings, the power employed and its derivation being stated for each group.

Another very interesting Table classifies operatives according to their employment under 6 main and 38 sub-headings. Of the textile factories, it may be noted that these employ 247,187 female, and 31,703 male operatives. Machine and iron factories employ 44,551 male, and 1,335 female operatives. Chemical factories employ 32,579 male, and 20,759 female workers. Food and drink factories employ 27,982 male, and 21,342 female workers. Miscellaneous factories employ 24,267 male, and 17,807 female workers.

Average daily wages.—The general tendency of Japanese wages since 1892 was that of a very steady rise in all industries until 1901, since which period wages have in most instances, slightly declined, slightly increasing in a few cases. The day rates in 1904 were as follows in the following selected and typical cases:—Carpenters, 0·590 yen; bricklayers, 0·570 yen; blacksmiths, 0·550 yen; compositors, 0·410 yen; shipwrights, 0·620 yen; cabinet-makers, 0·520 yen; farm labourers (male), 0·330 yen; farm labourers (female), 0·200 yen; weavers (male), 0·350 yen; weavers (female), 0·210 yen; paper-makers, 0·320 yen; jewellers, 0·480 yen.

Amount of chief manufactured goods.—In the Tables relating to this matter, first place is given to cotton spinning, a progressive and expanding industry. The number of mills at the end of 1904 was 74, the invested capital amounting in the aggregate to 34,699,554 yen. The average number of spindles worked daily was 1,306,198. The cotton mills alone consumed 404,291 tons of coal. Weaving has fallen off since 1900, both in regard to the number of looms and operatives, and also in regard to the value of the product. The total number of looms has declined in five years from 769,970 to 620,845, the number of operatives from 868,254 to 621,723, and the total value of the output from 178,172,629 yen to 129,295,099 yen. Paper factories are in a stable condition, the value of the production of Japanese paper being 13,543,837 yen in 1904, practically the average of the preceding six years.

European paper is in increasing demand, the output having grown in ten years from 2,619,338 yen to 9,803,961 yen. The values of other manufactured commodities in 1904, are as follows:—Earthenware and porcelain 7,268,570 yen, lacquered ware 4,477,294 yen, straw plaits 4,807,994 yen, camphor products 532,234 yen, and mats and matting 6,944,382 yen.

Government Factories.—Quite apart from the numerous naval and military arsenals with their ship-building, ordnance, steel foundry and machinery departments, there are a number of miscellaneous factories owned by the Government such as the paper factory and printing department belonging to the Government Printing Office, the mint, a woollen cloth manufactory, two factories for the manufacture of materials for telegraph and lighthouse purposes, and three factories belonging to the Government Railway Works Bureau. All these departments, regarded as a whole, give employment to 87,489 male and 17,411 female operatives, and consumed in 1904 some 394,000 tons of coal.

External Trade.—The export trade of Japan in 1905 reached the record value of 321,533,610 yen, or the equivalent of 6·70 yen per head of population. The imports were valued at 488,538,017 yen, or 10·18 yen per head of population. As to the general distribution of the exports, nearly one-third goes to China, and one-half to Asiatic countries generally. Roughly, one-sixth goes to European countries, Great Britain receiving one-fourth of the exports to Europe, or 1-24th of the whole export trade. France receives twice and the United States seven times as much as Great Britain. Of the imports, rather under two-fifths come from Asiatic countries, one-half of the Asiatic imports, or one-fifth of the whole, coming from British India. Practically another bare two-fifths of the imports comes from European countries, nearly two-thirds of this two-fifths coming from Great Britain. Rather over one-fifth comes from the United States.

As to the distribution of specific exports during 1905, the following leading items may be mentioned:—Copper, total value, 16,048,452 yen; exports to China, 13,658,003 yen; to Hong Kong, 1,439,559 yen; France, 403,486 yen; Great Britain 389,825 yen. Raw silk, total value 71,483,755 yen, exports to United States 53,825,893 yen, to France 10,999,503 yen, and to Italy 6,843,846 yen. Silk tissue (Habutæ), total value 28,057,980 yen, exports to United States 10,179,570 yen, to France 7,952,045 yen, to Great Britain 3,897,883 yen, to British India 2,852,823 yen. Cotton yarn, total value 33 246,462 yen, exports to China 28,693,913 yen, to Corea 3,252,992 yen, to Hong Kong 938,569 yen. Coal, total value 14,267,867 yen, exports to China 6,189,420 yen, to Hong Kong 4,619,533 yen, to the Straits Settlements 1,730,702 yen. Floor matting, total value 5,086,987 yen, exports to United States 4,679,307 yen.

The following may be cited as typical of the leading imports and their derivation:—Electric motors, total value 2,455,424 yen, imports from Germany 166,744 yen, from Great Britain 423,642 yen, and from the United States 1,859,748 yen. Locomotive engines, total value 2,466,561 yen, imports from Germany 1,219,203 yen, from Great Britain 295,503 yen, and from the United States 942,363 yen. Spinning machines and parts thereof, total value 1,419,346 yen, imports from Great Britain 1,282,712 yen, and from France 96,785 yen. Steam boilers and engines, total value 2,633,033 yen, imports from Great Britain 1,643,852 yen, and from the United States 894,223 yen. Turning lathes, total value 3,349,612 yen, imports from Great Britain 1,183,482 yen, and from the United States 1,902,836 yen. Rice, total value 47,981,265 yen, imports from British India 32,959,370 yen, and from French India 8,502,501 yen. Wheat, total value 4,012,092 yen, imports from Australia 1,229,672 yen, and from the United States 2,428,820 yen. Bar and rod iron, total value, 7,197,765 yen, of which the imports from Belgium totalled 4,306,987 yen. Tinned plate and sheet iron, total value, 4,698,063 yen; imports from Great Britain, 4,560,723 yen. Steel, total value, 2,339,189 yen; imports from Great Britain, 1,660,198 yen. Raw cotton, total value, 109,260,157 yen; imports from British India, 53,551,885 yen, from China, 16,778,273 yen, and from the United States, 35,166,304 yen. Cotton prints, total value, 1,392,977 yen; imports from Great Britain, 1,392,977 yen. Cotton satins, total value, 1,999,924 yen; imports from Great Britain, 1,999,878 yen. Grey shirtings, total value, 6,253,121 yen; imports from Great Britain, 6,248,547 yen. Wool, total value, 8,347,568 yen; imports from Australia, 1,530,145 yen, from British India, 1,043,071 yen, from Germany, 1,281,490 yen, and from Great Britain, 3,313,320 yen. Blankets, total value, 4,708,066 yen; imports from Great Britain, 4,500,257 yen. Coal, total value, 5,464,722 yen; imports from Great Britain, 5,457,705 yen. Steam vessels, total value, 7,660,293 yen; imports from Great Britain, 5,015,388 yen.

VICTORIAN EXHIBITS.

The State of Victoria has taken advantage of the Grocers' Exhibition at the Agricultural-hall to secure the minor hall for the purposes of an exhibit of the products of Victoria. These exhibitions are to be valued by all who desire the consolidation of the Empire. The people of the Mother Country have little knowledge of Greater Britain, and exhibits like the one under notice are most useful in bringing home to the people of the United Kingdom the enterprise and potentialities of the greater colonies. Inone respect the Victorian exhibit was handicapped. It is a little early in the season for exports from Victoria. In the fruit section, for example, only two varieties of apples, of small kinds, are at present available, and the fruit export of Victoria is becoming a very important item. But if the show of fresh fruit at the Exhibition is limited, the potentialities of

Victoria as a fruit-growing country are indicated by tempting samples of bottled fruits and jams. It may be questioned whether finer samples of bottled cherries, grapes, and other fruits have been seen in this country. Last year Victoria sent fruit to the value of £70,000 to the English market, and this is only a fraction of what the State is likely to do when the excellence of its bottled, canned, and dried fruits is better known.

Naturally, visitors to the Exhibition were particularly interested in the canned meat section, having in recollection the recent disclosures of Chicago practices. There would seem to be ground for confidence that the processes employed in the preservation of Australian meats leave little or nothing to be desired. All animals killed for consumption in Melbourne, and the surrounding districts, are rigidly inspected, and what is perhaps more important to buyers in the United Kingdom, this same rigidity of inspection is applied to meats intended for exportation. Tuberculosis disease in stock is rarely met with in Victoria. It is almost unknown in sheep in Australia, and as to cattle, probably no country in the world is freer of it than Victoria. Statistics show that only two per cent. of the pigs slaughtered are found to be tuberculous. Meats canned in Victoria for export are packed under exacting hygienic conditions. All the canning factories where meats are prepared for export are kept in a clean state, the law enforcing strict cleanliness, and all meats canned for export are closely inspected. The animals the flesh of which is intended for export purposes are examined first in the live state in the sale yards, then during slaughter at the abattoirs, and finally there is rigorous inspection at the canning works. No meats derived from animals that have suffered from any disease are allowed for export, and the Victorian system would seem to afford security against tainted meat reaching the cans.

Victoria still leads all the other Australian States in dairying. The output for last season exceeded that of the previous year by over 12 per cent. in quantity and 17 per cent. in value, constituting a record. The exports of butter from Victoria in 1905 were valued at £1,654,000, and the bulk came to London. A very interesting exhibit at the Agricultural-hall was made of butter in cases and tins, milk both concentrated and condensed, and other dairy products. Next month, under the auspices of the British Dairy Farmers' Association, Victoria will compete in the butter competitions at the Agricultural-hall. A stand at this week's Exhibition is devoted to a show of frozen and chilled meats, rabbits, fowls of an astonishing size and quantity, frozen eggs, lard, and tinned dripping, the latter an article which should make for itself a very ready market. Victoria last year shipped 1,181,138 cwt. of frozen and chilled meat, mostly to the United Kingdom. There are 35 varieties of canned meats at the Exhibition, but the processes for freezing fresh meat have so greatly improved that considerable inroads have been made upon canned meat exports.

An interesting exhibit is that of compressed fodder, for which a good market should be found. Wool, the production of which in Victoria last year was valued at £3,543,000, minerals, leather, tobacco, natural grasses, silk in cocoons, and many other products were shown at this excellently arranged Exhibition. Nor must the Victorian wines be forgotten. They were represented by champagnes, sherries, clarets, burgundies, and other wines. Victoria sends more wine to the United Kingdom than any other British colony, the annual output of something like 2,000,000 gallons being sent here for the most part. They are wholesome wines, sold at a very low price, and should in course of time win a large sale in the United Kingdom.

The following figures give the estimated value of Victoria products for 1904-5 :—

	1904. £	1905. £
Cultivation	7,728,421	6,216,213
Dairying and pastoral	10,837,410	10,494,308
Mining	3,361,455	3,420,136
Forest	586,725	610,567
Miscellaneous	1,760,350	1,725,571
Total primary products	24,274,361	22,466,795
Manufacturing value added during process.	9,661,250	9,185,238
	33,935,611	31,652,033

In 1905 the value of production per head of primary products was £20 0s. 5d., and of manufacturing (value added during process) £7 19s. 4d., making a total of £27 19s. 9d.

CO-OPERATION IN SOUTH AFRICA.

The report of Mr. H. J. Hannan, the Superintendent of Agricultural Co-operation, Cape of Good Hope, has been received. Mr. Hannan left for Capetown in September, 1905, and his report covers the period from September 20, 1905, to April 30, 1906. Very little headway has as yet been made in South Africa with co-operation, but Mr. Hannan thinks it might be of great service to the South African colonies. The urgency of dealing in some comprehensive way with dairying is suggested by statistics which show that last year the Cape Colony imported butter, cheese, and preserved milk to the aggregate value of £587,291. In the three years 1903-5 the dairy produce imported was valued at £1,961,332. "It is a sad reflection," says Mr. Hannan, "upon existing conditions that the population of the Cape must be supplied with their butter, cheese, and milk from Australia and the Argentine, with considerable profit to the farmers of those countries, and obviously at the expense of our own farmers." But in Australia and the Argentine the dairy industry has been developed though the formation in the first instance of co-operative societies, these, in their turn, establishing powerful federations to deal with the export of their

products. In both countries the breeding of dairy cattle has been especially attended to. The treatment of milk and cream has been reduced to a fine art on most farms, and up-to-date creameries, with the most complete equipment for the manufacture of a superior article, have been constructed at every suitable centre. Again, the poultry industry in South Africa has been largely neglected. During the last three years the imports of eggs and poultry reached a value of £356,246, and the co-operation that has done so much for this industry in Denmark and elsewhere might well put it upon a better footing in South Africa. One would think, too, that South Africa would grow her own hams and bacon, but last year they were imported to the value of £98,267. But perhaps it is in the improvement of their clips of wool that Cape farmers might reap the greatest advantage.

It is to South Africa—after Australia—that those interested in prime wool must look for that expansion of the industry which is necessary if the machinery of the world is to be kept supplied. Taking the year 1904, the world's supply of wool was obtained from various countries in the following proportions:—The United Kingdom, 6·20 per cent.; Continental Europe, 21·14 per cent.; North America, 14·33 per cent.; Australasia, 24·11 per cent.; South Africa, 3·35 per cent.; the River Plate, 20·86 per cent.; the balance coming from various countries, all in small quantities. The production of the United Kingdom is gradually diminishing, partly through the enclosure of old sheep walks on the moors and uplands for game purposes, partly from the large importations of frozen meat from New Zealand and the Argentina, which make sheep rearing for the purposes of food less profitable. The Continental supply is practically stationary, with a tendency to decrease; North America shows no tendency to increase its home supplies, and year by year the American manufacturers are becoming larger customers for Australia and the River Plate; Australia suffers from droughts, the last lasting nine years, and reducing its number of sheep from 101 millions to 54 millions; in the Argentine, the raising of corn and the breeding of cattle are supplanting sheep in some of the out districts, but developments are still expected in the districts which devote themselves to the frozen meat industry, so that the probability is that bred wool from that country will show a further expansion, but it is not anticipated that there will be any further increase in merinos. There is thus a promising market for the South African product if only South African farmers will pay more attention to the quality of the wool they sell. To-day, South African wool averages 25 per cent. more waste than it did a quarter of a century ago; it is sheared in dirty kraals; the unwise practice of shearing twice a year prevails. In time, it may be expected, the Agricultural Department will succeed in persuading Cape farmers that their interest lies in altering these practices, and in South Africa, as elsewhere, co-operation should play an important part in the improvement. Mr. Hannan is hopeful that it will do so, and there are passages in his voluminous, but very interesting report, which would seem to justify his hopefnlness.

THE BUSHMEN OF BASUTOLAND.*

The Dutch on arrival in South Africa found races of diminutive people occupying the ranges of mountains near Cape Town. They were afterwards found far to the north, and Moshesh found them in Basutoland when he occupied the country about 1820. The principal migrations to Basutoland occurred after the Great Trek of 1836. There were two parties, the first party lived at Hermon, near Wepener, and were known as Bushmen of Mamantso; they were tall and strong; they left Hermon and went to Little Caledon, where they stole cattle from Moshesh, were driven north to Teyateyaneng, and eventually retired with other clans to Griqualand East. The second party, known as Bushmen of Uphaki, went south to Quthing. When driven out they divided into two bands, and went up opposite banks of the Orange River. The principal leader was Swai, whose fate extinguished the Bushmen as a nation in Basutoland. The place-names in that part of the country are due to these bands. The last remnant also retired to Griqualand East.

The few Bushmen left in Basutoland are mostly half-breeds. They are very unwilling to talk of the past, and the Basuto dislike any attempt to glean information of the past history of the Bushmen. They have had no influence on the physique of other races. Their language was difficult and peculiar, abounded in clicks, of which traces persist in Sesuto and more extensively in Kafir. They are called Baroa by the Basuto, Abatwa by the Kafirs, San by themselves. The Bushman government was family, not tribal, and they lived mostly in caves. They were partly monogamous, partly polygamous. Loose family relations prevailed. Cattle was no inducement to polygamy as in other races.

Their food was mostly game, supplemented by roots dug up with the qibi or digging stick, or grass seeds. Little pottery was made. The paintings in their dwelling caves are very numerous; the colours used are mostly black and brown. Religion and magic—they called the storm spirit Qeng; believed in witchcraft, but did not practice "smelling" out. They marked the places where they buried their dead with small cairns of stones.

Bushmen place-names are very numerous in Basutoland, but the signification of most is unknown.

Their extinction was principally caused by their inability to change their mode of life; but a war of extermination was carried on by both Bantu and Europeans.

* Abstract of paper read before Section H., Ethnology, of the British Association, York, 1906, by S. S. Dornan.

ARTS AND CRAFTS.

THE MILAN EXHIBITION.

International exhibitions, much as we may affect to despise them, have their use for those who wish to study the progress of industrial art. They give us an opportunity which is otherwise seldom, if ever, to be had of seeing collected within a comparatively small area the most recent work of various nations in the different branches of the arts and crafts. It is unfortunate that the countries of Europe look upon exhibitions from such varying points of views that the lessons to be learnt from comparing their exhibits are not so many as they might be if the shows were collected upon somewhat the same principle. This want of system is very apparent in the exhibition now in progress at Milan. France has erected a large building labelled *l'art décoratif*, which, though it contains a good deal which hardly comes within the scope of decorative art, includes a fair-sized show of decorative work of various kinds, a good deal of which is art applied to manufacture. Germany has contented herself with a small show of a trady character. Hungary, on the other hand, sent a large and important exhibit which as it was housed in the same building with the Italian work, shared its fate and was entirely destroyed in the fire which ruined the *arte decorativa* in August. Holland has fitted up her section with a good deal of taste, and shows pottery, furniture, leatherwork, cotton hangings, embroidery and various other work very effectively. Still, one cannot help wondering how far her exhibits, with the exception of the Delft ware from Hilversum and some of the other pottery, are samples of what is being done commercially in the Low Countries. Belgium has devoted a wing of her pavilion to what she terms *l'art modern*, and has decorated it in the style which we should have called "up-to-date" a couple of years ago. It contains an interesting collection of furniture, embroidery and school of art designs, but practically nothing in the way of art applied to manufacture. Switzerland, on the contrary, is content to show a little rough peasant work and a good deal of the kind of stuff which finds a ready market at an exhibition. The English section suffers from want of arrangement. It is true that the objects shown form an exceedingly heterogeneous collection and are difficult to group, but it seems a pity that the exhibits could not have been pulled together a little by some connected scheme of decoration, instead of being left so completely to take care of themselves and swear at their next door neighbours. The ineffectiveness of the show is all the more to be regretted as it really contains a great deal of interesting work, more especially in pottery and bookbinding. Russia shows a mass of peasant work in wood-carving and embroidery, together with some traditional silversmith's work and enamelling, and Bulgaria reserves part of her very distinctive pavilion for embroidery and carpet weaving. Turkey and Japan turn the spaces allotted to them more or less into bazaars.

Jewellery.—The exhibits of the French and Italian goldsmiths are amongst the most interesting from the point of view of comparison, not only because they are large enough to be really representative, but because the French work, unlike what we have been seeing in London of recent years, is mainly trade work shown by firms of jewellers, and not by individual artists. It is, therefore, very interesting to note how thoroughly the French jewellery trade seems to have become imbued with the modern spirit. The trade work exhibited is naturally somewhat less distinguished and less daintily fanciful than the productions of well-known artists, but its characteristics are essentially the same; it is remarkable for its modernity of style, its straining after novelty, its tendency to a certain largeness, not to say heaviness of design and mass. And these distinctive features are no less strongly marked in a case of objects which are obviously Egyptian in style than they are in the exhibits which are not directly based upon any historic style at all. When we pass from this exhibit to the pavilion of the Italian goldsmiths we seem to have entered another world. Leaving aside a certain amount of work which from the point of view of art is quite uninteresting, the Italian show is characterised by a delicate and somewhat retiring refinement. To begin with, the workmanship, as we should naturally expect in the land of filagree, is of the lightest and finest, but beyond this the style is absolutely and entirely different. The best and most tasteful of the Italian work is based on a perfectly frank acceptance of traditional style, and if it is a trifle timid at times, and keeps rather close to its models, it is at least free from all restlessness and affectation.

Embroidery.—The craft which is perhaps most amply represented throughout the exhibition is embroidery. Nearly every country shows it—and even where it does not form part of the regular exhibits, it may be seen in the form of *appliqué* work used in the decoration of the sections, as curtains, banners, photograph surrounds, or what not. This last is naturally coarse work, very often executed by machine, but it is still very effective. The growth of this use of *appliqué* in recent years has been very marked. Not only for exhibition purposes, but in ordinary upholstery it has begun to take its place, and if this is more the case in Germany and Holland than it is over here, that may be in part due to the fact that labour is not so cheap with us as on the continent. Still, even in England, *appliqué* work is now done as an article of commerce. It strikes one as rather a pity that the effect of much of the work executed for exhibition hangings, &c., is marred by its bad outline. The applied material is often attached to the ground by a line of stitching or a couched cord

which is run well within the rim of the material and so leaves a raw edge beyond it which usually frays more or less. Probably, executed in heavy woollen material as most of this work is, the Eastern method of turning under the edge of the applied material (which is perhaps the simplest way of getting over the difficulty) would be clumsy—but it seems as though the unpleasant effect of the frayed edge could be avoided without any great extra expenditure of time and labour if only an effort were made.

Apart from this interesting *appliqué* work, which is only, as it were, part of the furniture of the exhibition, we see at Milan how much the craft of embroidery has come to the fore during recent years all over the continent. It has of late taken a more important place both in design and workmanship than it used to do, and it is, therefore, to be regretted that our exhibits at Milan consist chiefly of "old English" crewel work which, interesting as it is in a sense, does not at all show what is being done in the way of original work. The embroidery from Switzerland, again, follows the beaten track. On the whole the most interesting collection of needlework comes from Holland, and the exhibit is remarkable for its skilful and effective use of geometric pattern. The cushions and screens worked in cross-stitch form quite a feature of the show, and instead of looking dull and mechanical as so much cross-stitch work does, are tasteful and even striking in appearance, on account both of the distribution of the pattern and the happy combination of the colours employed. They are also skilfully planned so as to get their effect without involving much work. There is also a piece of inlay, or underlay—velvet in cloth—which, though rather unattractive in colour, is interesting as a suggestion and also because the method is comparatively seldom employed. A portion of the Dutch show consists of *appliqué* work in coarse woollen materials or rather on the lines of modern Swedish work. The most striking bit of embroidery from Belgium is a representation of a sunset in stitching—a very brilliant bit of colour. It is rather a shock to find the Japanese departing at times from their traditional designs, and working both landscape and floral panels after the European method. The effect is interesting, but not altogether pleasing.

The dominant note struck by the embroidery exhibited by all the countries, is simplicity. There is, on the whole, an absence of anything very new, or even very finished in technique—and the object of the exhibitors seems to have been rather to show that simple embroidery has a place in ordinary household decoration, that it is possible to produce such work without an undue amount of labour, and that it may be extremely effective, than to show what could be done in the way of fine technique or elaborate design. Of work demanding great patience or high technical skill there is very little shown—nor is there even much which leads us to suppose that the worker was interested in the technique of her craft as technique, and not merely as the shortest road to getting a desired effect.

GENERAL NOTES.

Indian Industrial and Agricultural Exhibition, 1906.—It is announced from India that it is intended to hold the annual Indian Industrial and Agricultural Exhibition at Calcutta, early in December this year, on ground acquired by the Bengal Government, and kindly lent for the purpose of the Exhibition. The first of these Exhibitions was held in Calcutta in December, 1901, and the others have since been held at Ahmedabad, in 1902, at Madras in 1903, at Bombay in 1904, and at Benares in 1905. Although that of 1906 is to be held simultaneously with the forthcoming National Congress, the members are not in any way expected to identify themselves with the politics of the Congress. Large guarantees have been given by many leading Bengal gentlemen and firms, and the Bengal Government have offered to give special facilities for the exhibition of appropriate collections from the Agricultural, Art, Forest, Sanitary, and other State departments. Arrangements will also be made for the exhibit of machinery and appliances of foreign manufacture likely to help and develop Indian industries. A special feature will be an Arcade, where exhibitors will be allowed to keep a stock of their exhibits for ready sale. All communications are to be addressed to the Honorary Secretary, Exhibition Office, 62, Bowbazan-street, Calcutta.

Protection in French Colonies. — In his report upon the trade of French Indo-China (Cd. 2682), Mr. Consul Carlisle gives some striking figures to illustrate the effect of the severe import duties levied on foreign goods. France and the French Colonies contributed 44·19 per cent. of the imports last year, Hong Kong coming next with 24·12 per cent., and China and Japan with 14.34 per cent. It is natural that Indo-China, being a French colony, governed by French officials, and containing a large French population, should import in a preponderating degree from France, but the figures quoted, 44·19 per cent., large as they are, do not indicate the extent of this preponderance. Much of the import consists of the natural products of the neighbouring countries which it is impossible for the Western nations to supply. Europe cannot supply the opium used, nor the rice, nor the fruits and seeds, nor the meat, hides, raw silk, birds' nests, &c., the dried fish, live sheep, and sucking pigs, and raw cotton, betel nut, pepper, fresh vegetables, and numerous other items. But taking what can be supplied from Europe, France is first, and her competitors nowhere. For example, she supplies 93 per cent. of the machinery, 91 per cent. of the cement, 87 per cent. of the cotton tissues, and 82 per cent. of the miscellaneous metal manufactures. The severe import duties keep out foreign goods.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

PRIZES FOR INDUSTRIAL DESIGN.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked, "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1907, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

PROCEEDINGS OF THE SOCIETY.

HOWARD LECTURES.

HIGH-SPEED ELECTRIC MACHINERY,
WITH SPECIAL REFERENCE TO
STEAM-TURBINE MACHINES.

By Professor Silvanus P. Thompson, D.Sc., F.R.S.

Lecture III.—Delivered February 1st, 1906.

Turbo-Alternators.

High speed, as we have it exemplified in steam turbines, involves a good many consequences when one comes to the design of machinery for generating alternating currents, for high speed involves a high surface-speed. We cannot have the one without the other because we cannot keep the diameters indefinitely small. The effect of the introduction of very high speeds upon the design and construction of alternators may be said to depend upon three extremely simple rules. The first is:—

$$p = \frac{120 \times f}{\text{R.P.M.}}; \quad \ldots\ldots\ldots \quad (1).$$

where p is the number of poles, and f the frequency or number of cycles per second. The number of poles is then dependent only upon the frequency that is prescribed for the system, and on the number of revolutions per minute of the machines. If, therefore, the consulting engineer prescribes the frequency, and the engine maker prescribes the speed, we have no choice as to the number of poles—the machine must be that number which fits the formula, and no other. For example, if an alternator is required to work at a frequency of 50 cycles per second, and the engine is a slow-speed engine of 150 R.P.M., the alternator must have 40 poles.

The second rule to which I wish to draw your attention as affecting the size is this: the relation between the pole-pitch, the surface speed, and the frequency.

$$\tau = \frac{v}{10 \times f}; \quad \ldots\ldots\ldots\ldots \quad (2).$$

where the surface speed, v, is expressed in feet per minute; f, the frequency, by the number of cycles per second; and τ is the pole-pitch in inches. The pole-pitch cannot be more or less than the number that you get by dividing the surface speed by 10 and by the frequency. For example, if we have an old-fashioned machine where the surface speed is 5,000 feet per minute, and if it is to be used in a supply system where the frequency is 50 cycles per second, we have 5,000 divided by ten times 50; that is to say, 10 inches and nothing less than 10 inches must be the pole-pitch for that machine.

The third rule which covers the design and construction of alternators is the well-known rule relating to centrifugal force.

$$F = 0{\cdot}0000284 \times R \times (\text{R.P.M.})^2 \ldots\ldots (3).$$

Here F is the centrifugal force, in pounds' weight, and R is the radius in inches. This formula then gives you, in pounds' weight, the force with which a pound of material at that particular radius, and running round at that particular speed, tends to fly out. It may be enormous in certain cases.

High Speed and Number of Poles.

Coming back to the first of these rules, which connects the frequency, the number of poles, and the number of revolutions per minute, I have deduced from it a useful Table.

Frequency (cycles per second).	Revolutions per minute.		
	Number of poles.		
	2	4	6
100	6,000	3,000	2,000
60	3,600	1,800	1,200
50	3,000	1,500	1,000
45	2,700	1,350	900
42	2,520	1,260	840
40	2,400	1,200	800
33⅓	2,000	1,000	667
30	1,800	900	600
25	1,500	750	500
20	1,200	600	400
16	960	480	320

Here we have the number of frequencies that may be taken as usual:—100 cycles and 60 cycles per second, which are used in America; 50 cycles per second used in England for lighting and power; 45 cycles per second, 42 cycles per second, and 40 cycles per second used on the Continent; 30 cycles per second used in America; and 25 cycles per second used in England, America, and on the Continent, for stations devoted to power work exclusively. The speeds at which the machines must run to give you these different frequencies depends on the number of poles, or rather, the number of poles depends on the speed.

Suppose we require to design an alternator of 1,000 kw. to work on a system where the frequency is 45; we have then three alternatives before us. We may design a two-pole machine, which must run at 2,700 revolutions; or a four-pole machine which must run at 1,350 revolutions, or a six-pole machine running at 900 revolutions.

Of course there are other solutions if we admit slow-speed machines. We might have a 36-pole machine running at 150 R.P.M., or a 50-pole machine running at 108 R.P.M., driven by a slow-speed engine. In the latter case the pole-pitch would be about 9 inches; hence the field magnet would become a magnet wheel some 12 feet in diameter with 50 radiating poles. But for steam turbines such designs are absolutely impossible. If the speed is to be over 1,000 R.P.M., the number of poles is necessarily small; and the centrifugal forces forbid large diameters.

High Speed and Size of Poles.

Seeing that these things hang together, we have to notice how the rest of the design and construction of the machine will follow. Comparing the high-speed machines with the low-speed machines, there will always be a small number of poles, and there will always be a wider pole-pitch because the surface speed is greater. If, instead of having 5,000 feet per minute for the surface speed, we have 15,000 feet per minute, then the pole-pitch necessarily becomes at once three times as great. Instead of having, therefore, a magnet-wheel of large diameter and small axial length, it will have one that is much smaller in diameter, relatively much longer, like a garden roller in style, and with fewer poles. The poles will be larger, and will have a larger pitch; and they will carry, as a general rule, a much larger magnetic flux.

Take two examples which I have here. Here (Fig. 28) is a design, $\frac{1}{15}$ scale, by the Oerlikon Company, of a machine designed for 1,500 kilovolt-amperes, having 72 poles, going at a speed of 83 revolutions per minute. It is a good standard-pattern slow-speed machine, with a 10-inch pole-pitch. Compare that machine with the design (Figs. 29 and 30), by Brown, Boveri, and Co., of a steam turbine alternator of 1,000 kw., to run at 1,500 R.P.M., and having four poles. The pole-pitch measured at the armature face is no less than 26·2 inches. The pole-pitch in the Oerlikon machine is almost exactly 10 inches. The diameter of the revolving part of that machine is 236 inches — nearly twenty feet — and the thickness of the machine from front to back only 9 inches. The turbo-alternator, which is of nearly equal power, has a diameter of 33·4 inches, and a length from front to back of 25½ inches. The poles

being longer, and having a greater pole-pitch, occupying on the average about 0·63 of the pole-pitch, it follows that the actual flux will be greater. In the old-fashioned kind of alternator, one seldom had more than four million or five million magnetic lines coming up through a pole. Modern high-speed alternators have much more. A machine of the fly-wheel pattern could not well be made much more than twelve inches thick from front to back, and it could not, for ordinary frequencies, have a pole-pitch of much more than 10 inches, and therefore a pole-span of more than 6 inches, so that 72 square inches is about the amount of pole surface that you would have. Then 72 square inches, at say 50,000 lines per square inch, gives as the flux 3·6 millions of lines. I do not say there would never be more or less. But when you have a pole-surface which, whether it is cut up or not, may be somewhere more nearly 20 inches in span along the periphery, and 25 inches or 30 inches, or even more, from front to back, naturally there will be a much larger area of pole-surface, and at the same flux-density there will obviously be a larger flux. Instead of thinking of four or five million lines, we have to think of twenty million or thirty million lines as the flux from one pole.

Table of Centrifugal Forces (in pounds per pound of material).

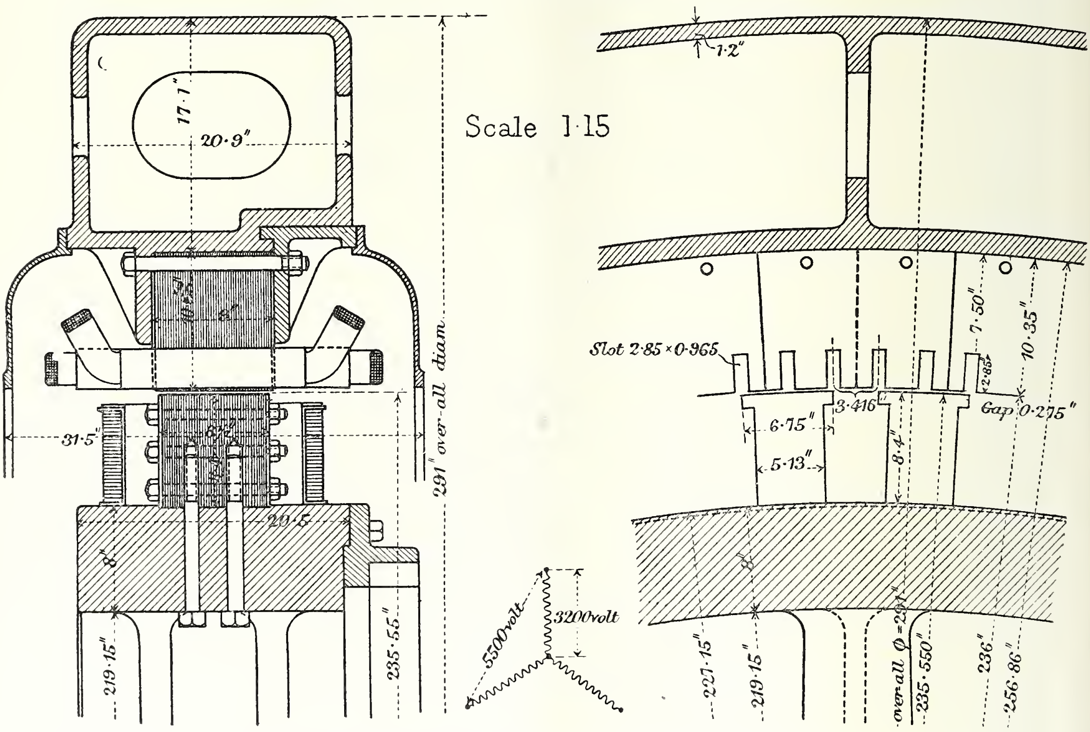
Radius in inches.	Revolutions per Minute.							
	750	1,000	1,250	1,500	2,000	2,500	3,000	3,500
10	160	284	444	640	1,136	1,775	2,560	3,480
12	192	341	532	767	1,364	2,130	3,070	4,170
14	224	398	621	894	1,590	2,485	3,580	4,870
16	255	454	710	1,022	1,815	2,840	4,090	5,570
18	287	511	799	1,150	2,045	3,195	4,600	6,260
20	319	568	888	1,280	2,272	3,550	5,120	6,960
22	351	625	976	1,406	2,500	3,905	5,620	7,650
24	383	682	1,065	1,533	2,730	4,260	6,130	8,350
26	415	738	1,154	1,660	2,950	4,615	6,640	9,040
28	448	796	1,242	1,790	3,180	4,970	7,160	9,740
30	479	852	1,332	1,920	3,408	5,325	7,670	10,440
32	511	909	1,420	2,045	3,635	5,680	8,180	11,120
34	543	966	1,509	2,170	3,865	6,035	8,690	11,830
36	575	1,023	1,598	2,300	4,090	6,390	9,200	12,520
38	607	1,079	1,686	2,430	4,320	6,745	9,710	13,220
40	638	1,136	1,776	2,560	4,544	7,100	10,240	13,920

High-speed and Centrifugal Forces.

With regard to the effects of high revolutions upon centrifugal force, the above Table has been compiled, giving the results of formula No. 3, worked out for a number of cases. Take, for instance, a machine the rotating part of which has a diameter of 33 inches, a radius therefore of $16\frac{1}{2}$, and which runs at 1,500 revolutions per minute; the Table, or the formula, will show you that every pound of material on the surface of this rotating part will tend to fly out with a force of more than 1,000 lbs, If we had one of 35 inches radius running at the same number of revolutions, we should have every pound of material on the surface tending to fly out with the force of a ton. Naturally, when we have to deal with such enormous centrifugal forces, which may go up even to 3 or 4 tons per lb., we have to employ structures in which every precaution has been taken to allow a sufficient margin of safety, the materials being of the very greatest strength and tenacity, free from all internal defects; and the pieces that go to make the revolving part, the iron, the copper, the insulation, and the hub, which holds the whole thing together, must be so contrived that you have the most perfect balance, in the engineering sense, of the parts; balanced not simply for statical forces and couples, but balanced dynamically, so that when running at a speed even higher than the normal, no harm shall occur by any resonance between the natural period of vibration of the revolving mass on its shaft and its bearings and the frequency of its revolution. And, further than this, the balancing of the revolving part must not only be perfect for the resent, but it must be perfect for the future.

It was soon found when machines of this kind began to be built that although you might balance a machine as it stood, if the greatest precautions were not taken, six weeks later they might be out of balance. In these constructions, where the stationary part and revolving part are subjected day by day to violent changes of temperature, they heat up and cool down; the materials expand and contract, and, if as the result of expanding and contracting they can creep, then there will be loss of balancing. That must be absolutely prevented, and the necessity of utmost solidity has a most marked effect upon the construction of the revolving parts.

FIG. 28.



SLOW-SPEED ALTERNATOR, WITH 72 POLES. (Oerlikon Co.)

CRITICAL SPEED.

One of the most serious things that can happen to high-speed machinery, is the occurrence of synchronism between the speed and the period of lateral vibration of the revolving mass between its bearings. Every shaft will bend slightly under the weight it carries. Supposing the shaft deflexion, expressed in fractions of an inch, be called D; then the speed that is critical may be reckoned in revolutions per minute by the rough-and-ready rule:—

$$\text{Critical speed} = 200 \times \sqrt{1 \div D}.$$

Thus, for example, if a machine had a deflexion of 1-900th of an inch, the critical speed at which the shaft would whip would be about 6,000 R.P.M. Now it may happen that in consequence of a sudden rupture of the circuit the load may be suddenly taken off a machine, and, unless the governor acts very promptly, that machine will begin to race. It is therefore of utmost importance that the shaft should be very stiff, so that the dangerous critical speed may be far above the normal speed of the machine.

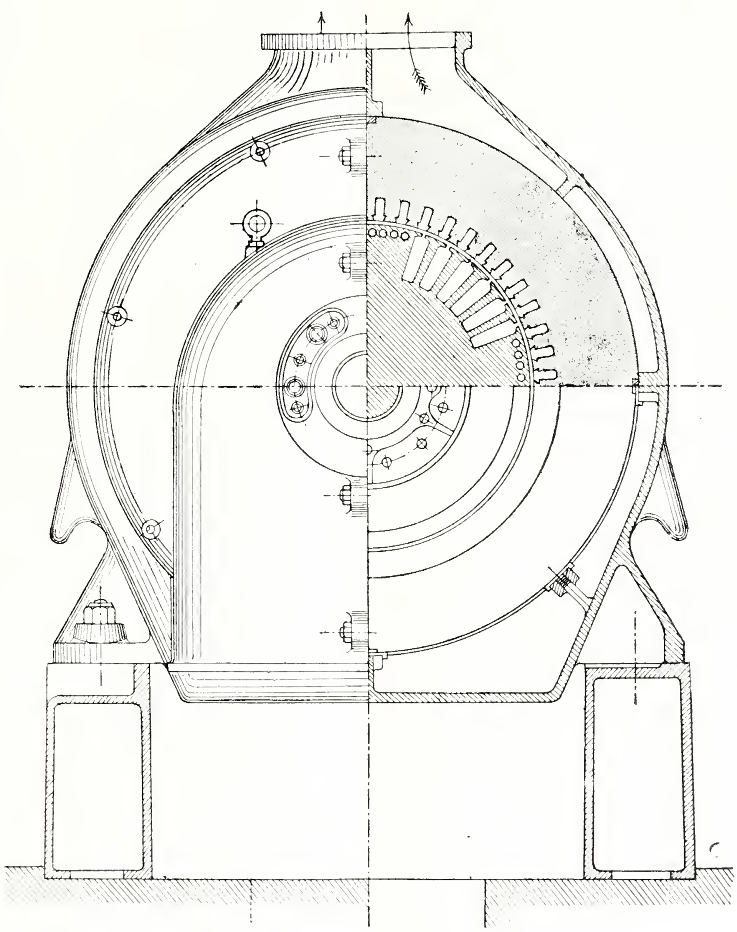
HIGH SURFACE-SPEED AND SPECIFIC DUTY.

The next thing to point out in the influence of these high speeds, is that because the surface-speed is high, you are able, as was shown in the first lecture, to get a higher specific duty out of the cubic inches of iron and copper in the active belt. But if we are making our cubic inch do more duty, and have a relatively less number of square inches of surface from

which to get rid of the heat, there is danger of the temperature rising too high. If, therefore, we would keep our machine cool, we have artificially to ventilate it in some way. We must increase artificially the number of available square inches of surface, and not trust to the high speed for ventilation, but force the ventilation in some way or other by providing special means for that purpose.

will be subjected to considerable forces. I do not say that any one-inch length of them will be subjected to higher forces than an inch length of the end bends of a smaller machine arching over 8 or 10 inches only. But there are more inches, and they have longer leverages. Also in case of an accidental short-circuit, the larger machine will have larger circuits induced in it. It is, therefore, impera-

Fig. 29.



Turbo-Alternator, with 4 poles, Tranverse Section. Scale 1 : 20. (Brown, Boveri and Co.)

Effect on Design of Stator.

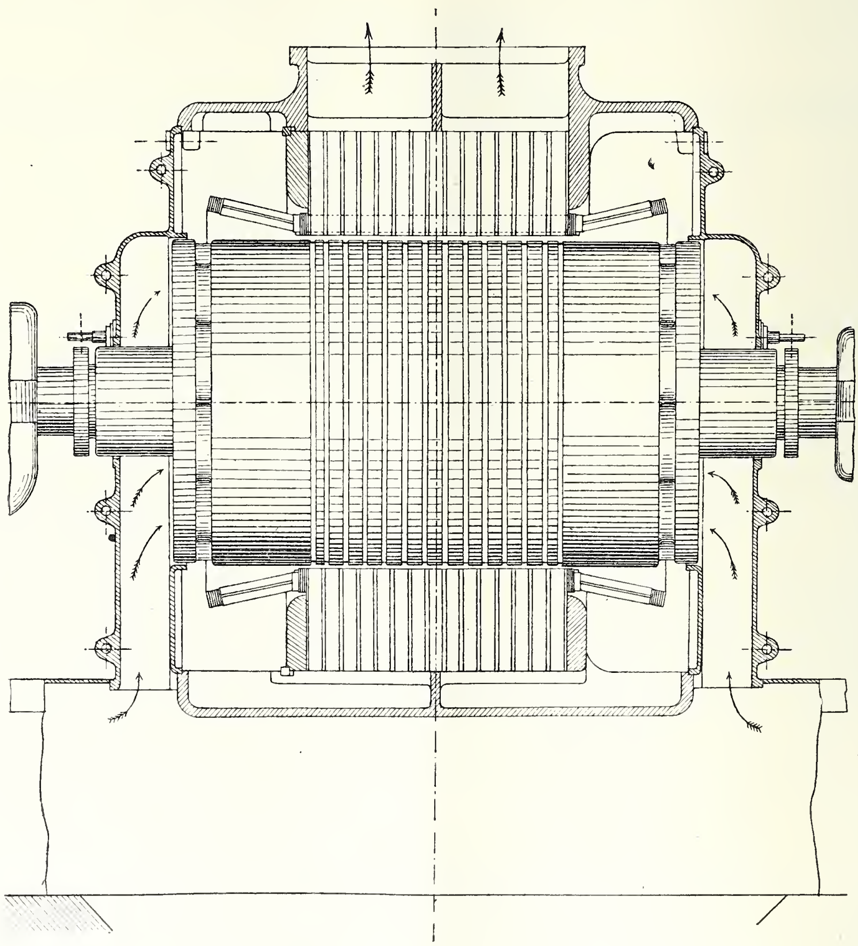
Then the fact that the pole-pitch is wide, introduces two further difficulties of construction, one relating to the winding, and the other relating to the iron of the stator. If the pole-pitch is wide, so that we have to wind in the slots of the stator coils which arch over a distance of 20 or 30 inches, it is clear that the end-bends will be relatively large; they will stand out more from the machine, and they

tive that the end bends be anchored by special supports to the housing, and they should be designed with this view, to guard them against mishap from the mechanical forces that come upon them in the event of a short circuit.

Then, again, for certain reasons which I need not here dwell upon further than to say that they arise from the need of making the voltage drop small, the air-gaps between the revolving part and the stationary part have to

be a great deal wider than was the practice in the old machines. With those wider gaps there is a larger amount of magnetic dispersion, and with that larger amount of magnetic dispersion at the ends, the forces on the end-bends increase. The end-bends are conductors carrying currents, and experience lateral mechanical forces because they lie in a magnetic field. And further, because the gap through the iron of the stator core from pole to pole, have to pass along a considerable arc spanning over an angle, not of some 5°, as they would do in a 72-pole machine, but (in a 4-pole machine) going over 90° or nearly so. It follows that the difference in length of path for the shortest lines and for those which have a maximum path from pole to pole will be very much more marked. With this highly curved

Fig. 30.



Turbo-Alternator, Longitudinal Section. (Brown, Boveri and Co.) Scale 1 : 20.

is wide, there will be a revolving stray magnetic field which can set up eddy currents in the metal shields or casings that protect the end-bends of winding. This is a new kind of danger never realized before the introduction of these steam turbine machines.

Then, as far as the iron of the stator is concerned, there is a new point. The poles are wide apart, and the magnetic lines going antipolar surface there is a greater tendency, therefore, for the magnetic lines to crowd up immediately behind the roots of the stator teeth. and for that reason a greater depth must be left behind the roots of the teeth, lest there should be too great a hysteresis loss in consequence of too high a saturation in that part. You will notice in turbo-alternators that there is an abnormal depth of iron in the stator.

Solidity of Rotor.

There is yet one other conclusion which would never have been suspected beforehand. Because of the absolute necessity of designing the revolving parts so that the windings shall not shift, in order that the future balance of parts shall be maintained, you cannot have fine wire winding on the revolving field-magnet. I was going to say that you cannot have any wire windings at all—if you call them windings you must do so in some modified sense. The windings must be so highly mechanical that they will consist of stout strips of copper, so anchored and so embedded that they cannot possibly shift. They must be thick; they must, therefore, be few; they must, therefore, carry a large current, and, therefore, the energy must be given to them at a low voltage, and the insulation upon them may then be reduced to a minimum. Instead of exciting at 200 or 500 volts, as was quite common in slow-speed alternators, we go down to 50 volts, and 20 volts, and 10 volts. In Lecture II. there was mentioned an exciter for a British Westinghouse alternator which works at 10 volts. I shall not be at all surprised if we have the exciters, and, therefore, the field-magnets of future turbo-alternators designed to work down to 5 volts. You gain in mechanical solidity, you save in the thickness of the insulation.

Output Formulæ.

Let us now revert to the fundamental formulæ of output of alternators which were given in Lecture I. These are

$$d \times l = \beta \times \text{KVA};$$

and

$$\beta = \frac{15{\cdot}9 \times 10^{10}}{k \times B_g \times q \times \psi \times v}$$

The factor, k, which appears in the denominator, has values from 1·11 to 1·06, according to the form-factor of the distribution of the magnetic flux and the concentration of the windings. If the magnetic flux is distributed as a sine-function in space, and the winding is concentrated in single slots, the value 1·11 is appropriate; but if the winding is distributed over 2, 3, or 4 slots per phase, the value goes down to 1·08, 1·07, or 1·06. For low-speed alternators, the pole-faces were usually concentric with the stator bore, but often bevelled off at the corners, giving a fringe of diminishing intensity. But in high-speed alternators great attention is given to the shaping of the poles to bring about an approximate sine-distribution of the flux. Hence it is difficult to assign particular values to ψ the ratio of pole-span to pole-pitch. If a sine-distribution is attained, then the ratio of the average value of the field to its maximum is mean value of the sines of all angles between 0° and 90°, namely 0·634. In other words, if B_g represent the flux-density at its maximum, where the gap is narrowest, then the average flux-density is $B_g \times \psi$, where ψ is the ratio of mean to maximum. In practice, ψ varies from 0·6 to 0·7; but is usually near 0·63. One reason why it is important to shape the pole-faces to secure a sine-variation, is the necessity of keeping down the hysteresis losses at low loads. The process of design by the use of the $d \times l$ formula, using the Steinmetz co-efficient β, is appropriate for alternators, while the use of the $a^2 \times l$ formula, using the Esson co-efficient ξ, is appropriate for continuous-current dynamos, because in the former case peripheral speed is a dominant factor in the design, whilst, in the latter case, the dominant question is good commutation; and peripheral speed is of but secondary importance. Since then we can, in the case of alternators, fix beforehand, from the result of experience, all the factors, k, B_g, q, ψ, and v, the calculation of the Steinmetz co-efficient, and consequently of the leading dimensions, d and l, becomes a rational process.

Suppose, for example, we have to design a turbo-alternator of 3-phase pattern, working at 5,000 volts between lines (*i.e.* 2,886 volts in each phase), and giving three currents of 475 amperes each, at 40 cycles per second. Then $3 \times 2{,}886 \times 475 \div 1{,}000 = 4{,}120$ K.V.A. By the Table of frequencies given above (p. 1046) the frequency of 40 limits us to one of the following speeds:—2,400 R.P.M., 1,200 R.P.M., and 800 R.P.M.—, according as whether the revolving field-magnet is designed with 2, 4, or 6 poles. The turbine-maker would probably not wish to construct a 5,000 horse-power turbine at 2,400 R.P.M., but would prefer one at 1,200 R.P.M.; so that this involves a 4-pole design. Now if, as the result of experience, we adopt the following values:—$k = 1{\cdot}08$, $B_g = 42{,}000$, $q = 667$, $\psi = 0{\cdot}63$, $v = 13{,}600$; inserting these in the formula will give as the Steinmetz co-efficient $\beta = 0{\cdot}64$. This gives $d \times l = 2{,}513$. If v is not to exceed 13,600 feet per minute, then d cannot exceed 43·3 inches. If d is taken at 43 inches then l will be 38·8 inches, and the pole-pitch will be 33·75 inches.

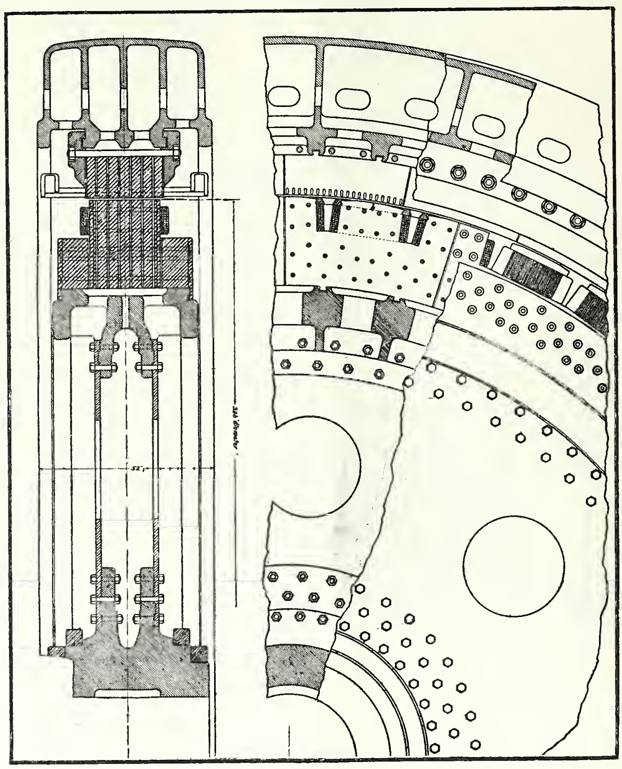
Consideration of these design formulæ will bring out several points. In the older fly-wheel

type of alternator, with a foundation wheel of cast iron, it was not safe to use a peripheral speed of more than 5,000 feet per minute. If then as the further result of experience it was found that the gap-density could not well be more than 40,000 lines per square inch without making no-load losses too great, and that the specific loading q could not be made more than 650 amperes per inch without causing the voltage drop at full load to be too great, it followed that in such machines the co-efficient β could not well be reduced below 2 or 2·5. But if by the circumstance that by adopting the special rotor construction appropriate for turbine work, and the consequent use of steel structures, surface-speeds of 15,000 feet per minute can be safely attained, it follows that, other things being equal, the co-efficient β will come down to one-third of its former value: that is, one can construct machines having but one-third the amount of polar surface for an equal output. If we turn to the facts, we find that for eight recent turbo-alternators, some of which are illustrated in the drawings exhibited, the values of the output co-efficients run as follows:—0·65, 0·76, 1·18, 0·74, 0·72, 0·86, 1·17, and 1·4. These figures indicate a very important reduction in material needed in construction.

Some Contrasts in Design.

By way of contrast, consider the largest machines of the older type that have been built. These are the eight machines furnished by the Westinghouse Company, of Pittsburg, to the Manhattan Station in New York. They are 3-phase machines of 5,000 kw. each, having 40 poles, and making 75 R.P.M. The diameter of the rotating magnet wheel is no less than 336 inches—28 feet—while the axial length of the pole-core is 22 inches, so that $d \times l = 7392$, and β is therefore 1·48. The peripheral speed, even though the whole revolving structure is built up of steel, is only 6,710 feet per minute. Fig. 31 depicts a section of one of these machines, showing the structure of the revolving part, the six ventilating ducts, and the elaborately-stiffened construction of the stator housing. These Manhattan machines are most imposing, with their huge vertical engines

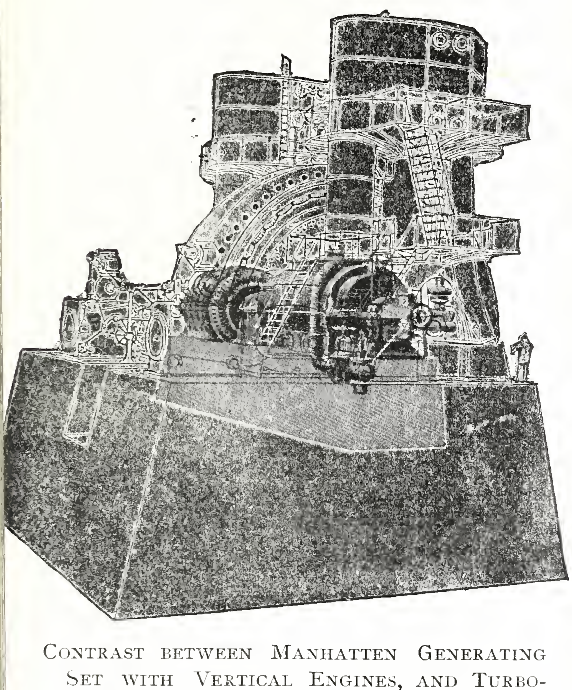
Fig. 31.



Design of Manhattan Slow Speed Alternator (Westinghouse Company.)

of marine type. But there will be no more built. Compare one of these sets with a modern Westinghouse turbine set, of equal output, and the comparison at once shows the great saving, not simply in steel and copper, but in floor space and foundations. Fig. 32 is one furnished by the engineers of the Westinghouse Company themselves. Revolving at 1,000 R.P.M., and with a diameter of 67 inches, the peripheral speed attained is over 17,600 feet per minute, and the co-efficient β comes down to 0·65.

FIG. 32.



CONTRAST BETWEEN MANHATTEN GENERATING SET WITH VERTICAL ENGINES, AND TURBO-GENERATING SET OF EQUAL OUTPUT (British Westinghouse Company).

As in many other departments of electrical machinery, so here, the design will be modified according as the requirement is for a machine that is to work on a continuous full load, or on a variable load in which for a large percentage of the time the output is small; for in the latter case the iron losses (which are nearly constant at all loads) must be kept low, whilst in the former case they may be relatively high—equal, in fact, to the full-load copper losses. Hence, in machines coming under the former case it is permissible to use higher flux densities, and therefore also the specific electric loading may be higher, as with the higher magnetic densities there is less voltage drop due to distortion. Of course, there will be more heat generated, and adequate ventilation must be provided; but, assuming this to be done, if the machine is designed for higher values of B_g and q, the value of co-efficient β will be correspondingly reduced; that is, the size of machine will be smaller in proportion to its output.

STRUCTURAL DETAILS.

We pass on to the modifications which are brought into the revolving field-magnet by the necessity laid upon the designer of obviating all risk of change in the balancing, and all chance of accidents from excessive centrifugal forces. In the older type the individual pole cores were masses of either assembled stampings of laminated mild steel, or else blocks of cast steel, screwed to, or bolted to, or dovetailed into the rim of the fly-wheel structure which served as foundation. This rim was usually first calculated out of the size to give the requisite pole-pitch at the prescribed speed, and of a sufficient cross-section to carry the magnetic flux as a yoke between pole and pole. Then, as it was necessary that the magnet-wheel should really act as a fly-wheel to minimize the inequality of angular speed of the reciprocating steam engine (which inequality gave rise to difficulties in synchronizing and in parallel working) it was the fashion to thicken up the foundation rim until the required moment of inertia should be attained. The magnet-wheel then became a fly-wheel with an enormous rim, from which the poles projected. Each pole being surrounded by an exciting coil of strip copper wound edgewise. This coil was itself held down against centrifugal forces either by the overhanging tips of the poles, or else held in a bronze bobbin secured by special bolts. In some cases—the Manhattan machines for example—the laminated pole cores formed projections from a continuous, built-up, laminated structure, and therefore needed no bolts to hold them in. But all these plans have had to be abandoned in view of the enormous centrifugal forces in turbo-alternators. Poles, foundation wheel, and shaft are all merged into one structure. The magnet-wheel has become a solid rotor, with magnetizing windings embedded in its mass, and is scarcely recognisable at first as a field-magnet.

PARSONS' TURBO-ALTERNATORS.

Such changes do not come about all at once, they are the result of development. In the early forms of Parsons' alternators of some

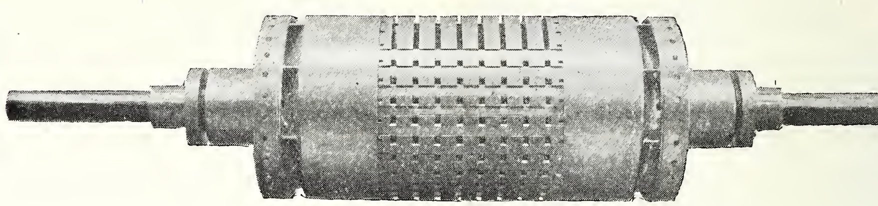
fourteen years ago, the bipolar field-magnets were fixed and external, the armature revolving within. Eight or nine years later the alternator had become a four-pole machine of larger size, and the copper conductors on the revolving armature were now carried through tunnel slots under the periphery of the core-disks. But these constructions have been found inadequate. All the inventors who have essayed revolving armatures have abandoned them; and, at the present time, all the makers of turbo-alternators design them with the armature fixed and external, and the field-magnet internal and revolving. In Parsons' recent alternators the field-magnet is a solid block of steel, of cruciform section. Upon each arm of the cross is carried an exciting coil of copper strip. This is secured from flying out radially by the application of heavy pole-shoes which are dove-tailed along the whole length of the pole, and the coils are further secured in place by bronze corner-pieces bolted down into the inner body of the magnet. The shaft is in two parts, pressed into the ends of the solid rotor body by hydraulic pressure. The polar surfaces are not concentric with the armature face, but are shaped off so as to secure a better distribution of the flux. Further, the polar surface is itself divided by a number of cuts turned around it at regular intervals, leaving a number of projecting ridges which become more highly saturated than the rest of the core, thus tending to avoid distortion of the flux. The stationary armature, built up of assembled laminations, is provided with numerous ventilating ducts that are kept open by the insertion of spacing-pieces. Air drawn into the interior finds its way through these ventilating ducts, and so keeps the windings cool. The stator core-rings are mounted within the housing in such a way as to leave a surrounding hollow chamber within the external shell. At the top the shell has an opening resembling a short chimney; so that the air which passes into the chamber rises out at the top, and ventilates by a natural draught. The interior hollow space is arranged with baffles to guide the flow of air, so that every part is properly ventilated.

The large Parsons' alternators at Carville, Newcastle, are 4-pole machines of 5,000 kw., and work at 1,200 R.P.M. The turbines are of 8,000 H.P.

Other Constructors.

On the Continent, the principal licensee of Mr. Parsons, is the firm of Brown, Boveri and Co., of Baden, Switzerland. Mr. C. E. L. Brown took up the design of the turbo-alternator at the point where it had been found impracticable to use revolving armatures; and the development of the type, with revolving field-magnets, is largely due to him. The special type of revolving field-magnet created by Brown, Boveri and Co., is illustrated by Fig. 33, depicting a bipolar structure for a small alternator of 200 kw., working at 2,400 R.P.M., on a system of 400 cycles per second. The body of the magnet is a solid cylinder of steel, with two projecting hubs at the ends, into which the shafts are squeezed by hydraulic pressure. Eight circular ducts, about one inch wide, are turned in the steel face. Also longitudinal slots, with overhanging tips, are ploughed along the core to receive the windings; and the slots when so filled are closed by the insertion of wedges. Over the end-bends, bronze caps are fitted; these caps being furnished with blade-like structures which promote the ventilation by fanning. The exciting current is introduced through a single steel slip-ring at each end. The surface of the revolving part presents, therefore, an almost unbroken periphery—a form that is preferred because it is less noisy than those which have salient poles. Pockets are provided, both in the steel core and in the bronze caps, for the insertion of lead masses for balancing; for it is found expedient to balance

Fig. 33.



the core before it is wound, and again after the winding is completed.

Figs. 29 and 30 depict a three-phase Brown turbo-alternator of 1,000 k.w. at 1,500 R.P.M., designed to give 3 currents of 289 amperes at 2,000 volts between the lines. The peripheral speed at the rotor face is 12,600 feet per minute, the diameter being 33·4 inches, and the core length 25·5 inches. The mean value of the flux density over the pole face is 32,500 lines per square inch. The stator core discs have 48 slots, with 4 conductors per slot. The rotor has 4 poles, with six large slots between each pole and its neighbours, the magnetising winding around any pole being inserted in 3 slots on each side of that pole. It is evident, therefore, that each pole, considered by itself, consists of a middle solid part which has a maximum number of exciting coils surrounding it, and of neighbouring parts which are surrounded by a smaller number of exciting turns. This arrangement leads to a distribution of magnetic flux approximating roughly to a sine distribution.

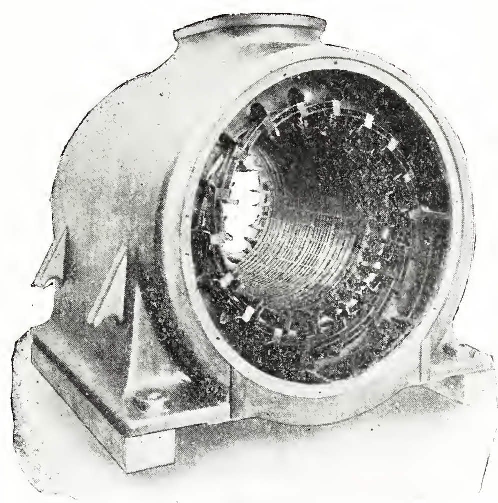
Attention is directed to the ventilating arrangements of this alternator. The housing of the stator is extended at the ends to form two chambers covering the projecting hubs. Into these two chambers air is admitted from below, as shown by the arrows. This air is caught by the fans on the bronze caps of the rotor, and driven past the end-bends of the stator winding into the shell of the housing, then up through the air ducts between the laminations, and finally out of the chimney at the top.

The stator winding of a turbo-alternator may be carried out in various different ways. The particular way adopted in the Brown-Boveri machine, Fig. 30, is not usual, nor is it characteristic of the latest machines of that firm. As will be seen from the sketch, the conductors are in two layers in the slots, and the end-bends are united in a manner resembling the barrel winding of a continuous-current drum armature, the winding being a wave-winding which, in the present instance, is interrupted at three points, so as to furnish the three phases. This type of construction is good so far as the ready ventilation of the end-bends is concerned, but is not desirable so far as relates to their mechanical support.

Another type of stator winding is that so common in alternators of the older species, in which the end bends project out in two or three ranges. Here, again, there is a necessity for brackets to anchor the projecting parts, because of the enormous mechanical forces which come upon the conductors, particularly in the event of a short circuit.

A third type of stator winding is that in which each "coil" has a long and a short side, and the end-bends or connectors all spiral over equal chords, helical twists that lie in the same direction. This kind is sometimes known as "basket winding," because of its outward resemblance to imbricated wicker-work. An example is afforded by Fig. 34, which depicts the stator of a Brown-Boveri alternator of 1,000 kw. at 1,500 R.P.M. This is a low-voltage machine, giving three currents of 1,563 amperes each, at 370 volts between lines. There are consequently only very few conductors of very thick copper. The end-bends support one another very compactly. There is less self-induction than with those types where the end-bends project further into space.

Fig. 34.



Stationary Armature of Turbo-Alternator (Brown, Boveri and Co.)

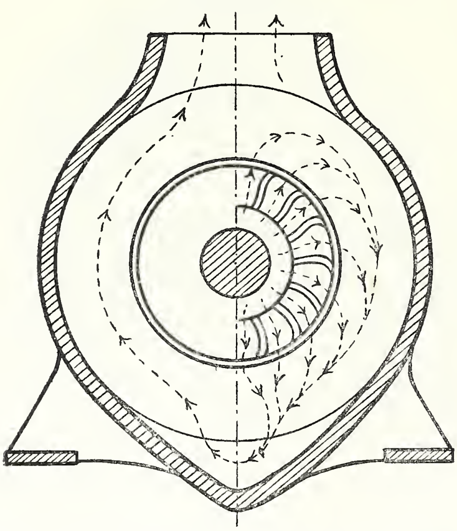
Ventilation has been referred to as a prime consideration in turbo-alternators. In no other piece of electric apparatus is so much power concentrated in so small a volume. For example, in the four-pole Brown machine, Figs. 29 and 30, 1,340 horse-power are converted into electric power in a stator containing about 4,300 cubic inches of copper and steel. If by reason of a short circuit this amount of power could be concentrated on the metal of the stator, the energy developed as heat would suffice to raise

the whole mass to a red-heat within three minutes. If only 1 per cent. of the energy is wasted on heating the copper and iron, the external surface would be quite inadequate to get rid of the heat unless the temperature rose far above the permissible limits. Hence the necessity of numerous ducts and of contrivances for ensuring that the air shall circulate through them. If the mere peripheral surface is reckoned out, it may be taken that, with the high peripheral speeds of 10,000 to 16,000 feet per minute each square inch can get rid of one-sixth to one-tenth of a watt for a temperature rise of 1° Centigrade. Or, if a temperature-rise of 35° Centigrade is permitted, the armature can get rid of from 6 to $3\frac{1}{2}$ watts for each inch of its peripheral surface.

The completed form of the Brown turbo alternator is illustrated by Fig. 37, which depicts one of the sets of 10,000 horse-power constructed in the shops of that firm at Mannheim for erection in the St. Denis power-house of the Paris Metropolitan railway. The turbine runs at 750 R.P.M., driving the 6,000 kw. three-phase alternator, which generates its current at 10,250 volts.

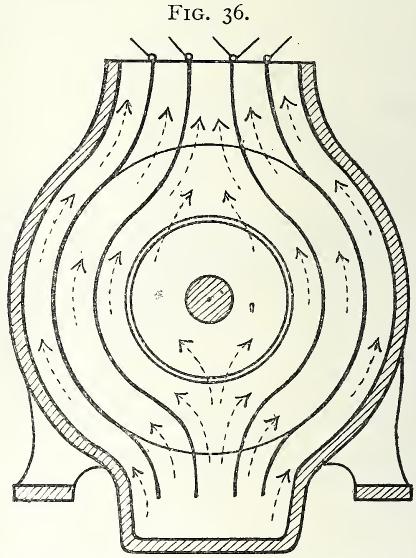
Other makers adopt different plans. In the machines of Dick, Kerr and Co.,* and in some of those of the Westinghouse Company, the stator housing is made with large apertures perforated at intervals all over to secure free access of air, with no attempt at internal baffles. The Allgemeine Company has essayed another plan, bolting together between strong end shields the stator core-rings, but entirely omitting any external housing, and thus securing the most complete access of air to the stator iron.

Fig. 35.



Ventilation Scheme. (Brown, Boveri and Co.)

Fig. 36.



Ventilation Scheme. (Oerlikon Company.)

The methods that have been proposed for bringing about an effective circulation of air may be further illustrated by the two diagrams of Figs. 35 and 36. The first of these is due to M. Aichele, of Brown, Boveri and Co., in which fans at the ends of the rotor draw in air and send it first downward and then upward through successive quarters of the machine. Fig. 36 illustrates a method devised by the Oerlikon Company. Here the ventilating ducts are divided by baffles which go from top to bottom, thereby causing the air to traverse definite passages ending in ventilating openings at the top. Over these various openings there are lids which can be raised or lowered if it is found that any one part of the machine requires to be more thoroughly ventilated then another.

The British Thomson-Houston Company, following the initiative of the General Electric Company of Schenectady, has adopted the vertical pattern of Curtis turbine, and manufactures turbo-alternators up to 5,000 kw. The design of these machines has recently been described in the *Electrician* † in an excellent article by Mr. H. S. Meyer. The revolving field-magnets of these machines have definite salient poles. The ventilating arrangements are peculiar. Between the poles are bronze corner-pieces to clamp the windings.

* See the *Electrician*, lvi., p. 218, Nov. 24, 1905.

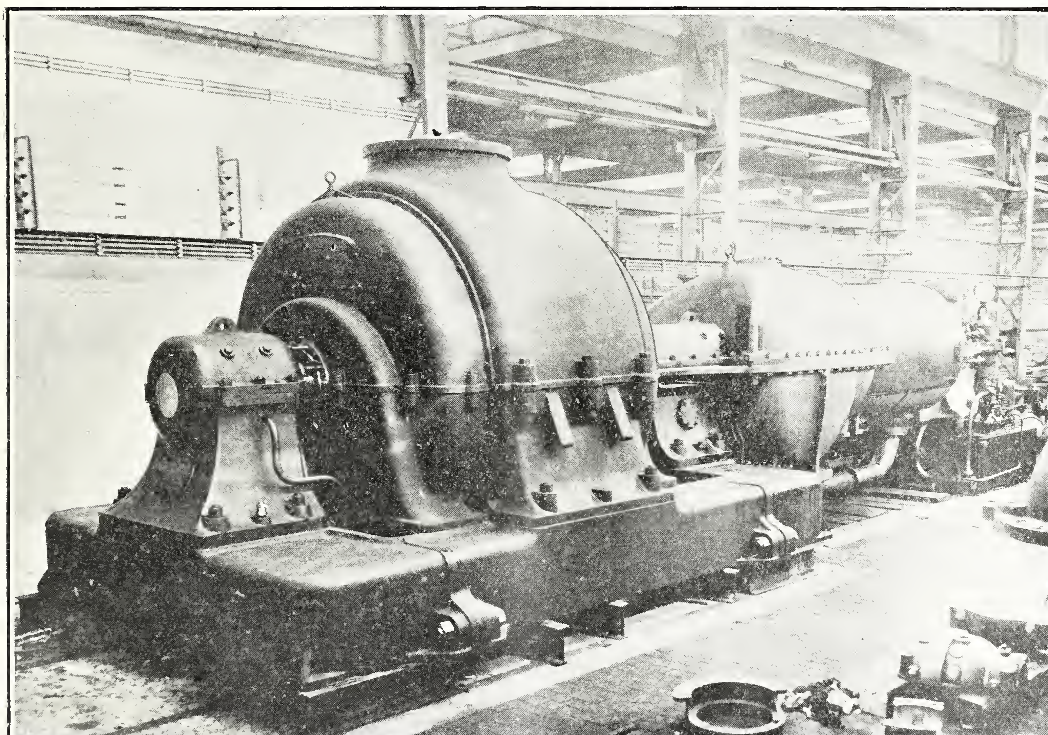
† *Ibid*, lvi., p. 498, Jan. 12, 1906.

These are provided on their outer surfaces with projecting ridges which are not concentric, but which are disposed skew-wise, so that they act like the blades of a windmill. When in revolution these blades draw in air and propel it downwards through the turbine. The downward direction is chosen because, as the alternator is mounted on the top of the turbine, it is very important to prevent hot air or stray steam from a leaky gland from rising and getting access to the insulation of the windings.

It is impossible in so short a course of lectures to do justice to the various designs which have been produced by different firms. Messrs. Siemens Bros., and the Siemens-Schuckert Works have produced turbo-alternators; so also has the Bullock Company of Cincinnati, from the designs of Mr. Behrend; so also have Messrs. Kolben and Co., of Prag. The two last mentioned firms have adopted the form of rotor with cylindrical periphery, as have also the British Westinghouse Co., in its latest types.

The Oerlikon Company has essayed a number of different types, including one most ingenious but delicate pattern of the inductor type, having both the exciting coils and the armature coils fixed, and with nothing revolving except masses of steel. They have also designed machines with hexapolar revolving magnets, having projecting poles. In their present types, of which a large scale drawing has been kindly furnished me, the rotor is of cylindrical pattern, with numerous large open slots, within some of which the exciting coils are wound, giving a gradation of flux over the poles.

Fig. 37.



Turbo-Alternator Set of 6,000 KW., at 750 R.P.M. (Brown, Boveri and Co.)

Fig. 38 illustrates the design of a 2-pole, 1,500 kw., 50 cycle alternator (three-phase) revolving at 1,500 R.P.M. The stator bore is 34 inches in diameter, and the gross core-length 56 inches. The stator has 48 slots, with two conductors per slot. The rotor has 36 slots, with 46 conductors per slot.

We may compare with the 4-pole Brown machine, another 4-pole 1,000 kw. alternator supplied to the Bristol Corporation by Messrs. Dick, Kerr and Co. The comparison supplies several contrasts. The Preston firm uses

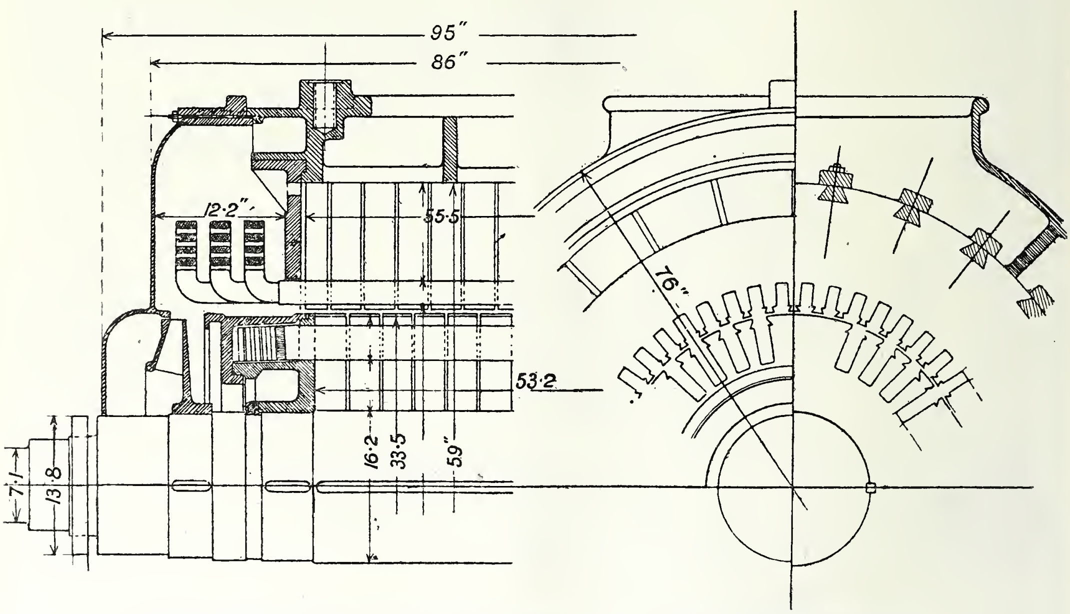
in this machine (Fig. 39) the basket winding in preference to the in-and-out winding in two or three ranges. They have the coil-ends bent spirally round. Working drawings of these machines are on the wall, and from them you can see the large number of ventilating ducts, and the way in which the exciting coils are held in between the poles by means of corner pieces.

A larger machine of Dick, Kerr and Co. of 3,000 kw., 750 R.P.M., has been supplied to the Corporation of Glasgow. In this case there is a three-range winding, with the end-bends strongly bound together. Brackets are employed to prevent the coils from shifting. There is no attempt to insert baffles or provide flues, but there is a very thorough ventilation by holes through the housing, and by ducts in the interior through the coil. The whole of the pole-structure is laminated at the tips, and there are ducts for ventilating all along through the revolving poles. The pattern of revolving field-magnet used in the Dick, Kerr machines is well illustrated by Fig. 40, kindly supplied by the *Electrician* Company.

Specific Utilization.

In my first lecture I pointed out these factors of specific utilization and dwelt upon them, and how we can make the best use of the cubic inch of material in the active belt. There are the three factors—the gross current density, the gross magnetic density, and the peripheral speed (in this case the figures of the Table on p. 1060 are in inches per second); the product of the three, divided by ten to the seventh power, giving the number of watts per cubic inch of active belt. For the old style of alternator I have taken a number of typical machines. Taking the machines of the old-fashioned, slow-speed type, the number of watts per cubic inch lie between 57 and 81; but the turbo-alternators, with their higher surface speeds, give higher values ranging from 117 to 288, with an average value of 175.

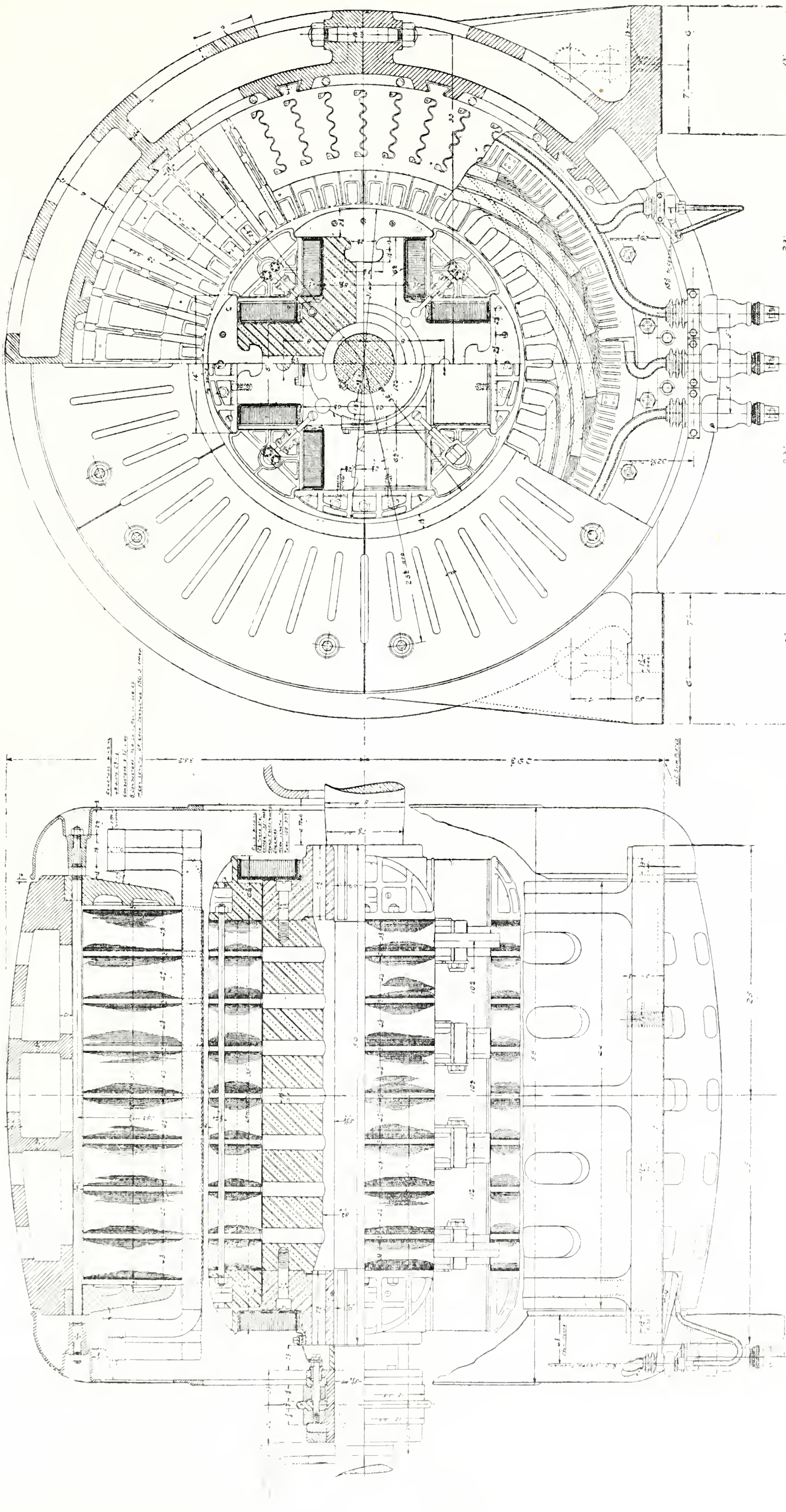
Fig. 38.



Three-phase Turbo-Alternator, ATB2—1500—1500. (Oerlikon Company.)

The figures of specific utilization amply show that for a given quantity of iron and copper a very considerably higher duty is attained by adopting high-speed driving. Whatever critics may think, or however much engineers may gibe at these high speeds, and say they prefer to use something they can watch revolving, it is quite certain that steam turbines have come for good into the electrical industry. Whether the old-fashioned engineers like them or not, it is perfectly clear that turbines are being adopted wholesale, and that they are replacing other types. It has not yet been shown that from the point of view of steam consumption, they take fewer pounds of steam for a given amount of output, but there are very high figures claimed, I know, for some of the sets, particularly the Brown-Parsons sets tested at

FIG. 39.

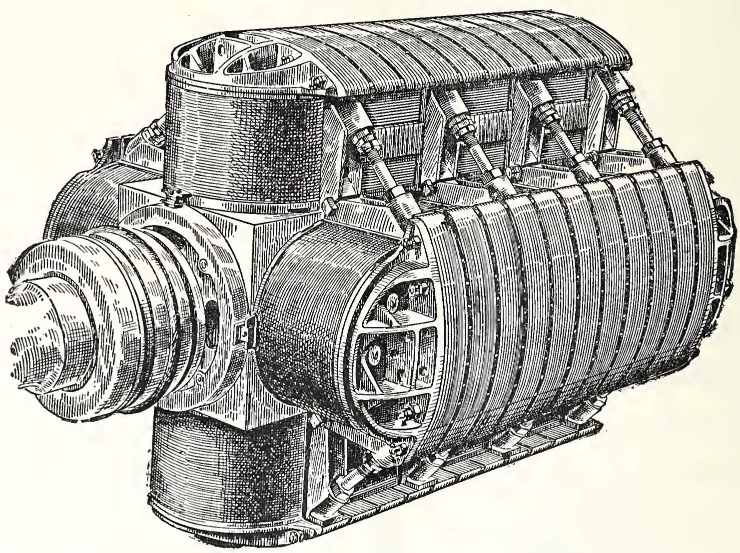


TURBO-ALTERNATOR. (Dick, Kerr and Co.)

UTILIZATION CO-EFFICIENTS OF SLOW-SPEED AND HIGH-SPEED ALTERNATORS.

	α'	β'	γ'	Watts per cubic inch.
Slow-speed Alternators.				
Oerlikon ....ATB 72 — 1,500 — 83..........	208	36,000	1,023	71·8
Heyland ....ATB 64 — 760 — 94..........	236	26,000	1,160	71·2
Oerlikon ....ATB 10 — 290 — 600..........	286	27,400	1,030	81
Brown ......ATB 28 — 1,640 — 180..........	153	25,500	1,524	59
Kolben......AQB 96 — 3,500 — 75..........	208	24,600	1,180	57·1
WestinghouseAQA 62 — 1,500 — 116..........	261	25,500	1,214	81
Turbo-Alternators.				
Parsons......ATB 4 — 3,500 — 1,200	300	23,700	2,625	188
Westinghouse ATB 4 — 1,800 — 1,500	271·5	26,000	3,020	212
Brown ......ATB 4 — 1,000 — 1,500	420	25,500	2,620	288
B.T.H. Co. ..ATB 6 — 1,880 — 1,000	199	30,800	2,480	168
B.T.H. Co. ..ATB 6 — 1,500 — 1,500	186	31,300	3,760	157
Dick Kerr ..ATB 4 — 1,000 — 1,500	144	29,100	2,560	127
Dick Kerr ..ATB 4 — 3,000 — 750	113	52,000	2,040	122
Dick Kerr ..AQB 6 — 3,000 — 1,200	255	33,000	2,582	212
Oerlikon ....ATB 2 — 1,500 — 1,500	200	11,000	2,740	117

FIG. 40.



FIELD-MAGNET WITH SALIENT POLES. (Dick, Kerr and Co.)

Frankfort. They have proved themselves quite equal to, and some people say better than, large compound condensing reciprocating engines. But it is not there, to my mind, that the advantages lie; the advantages are other. You gain in some respects, you lose in other respects. You gain in simplicity, in the small number of moving parts, in the simplicity of lubrication, and lose in that the moving parts go so quick that you cannot be sure what is happening to them. The moving parts are not so accessible as those of the low speed machine; but then there is no need of access for months together. This is a purely steam engineers' question into which I do not dare to enter. I have tried to avoid all criticisms upon the steam-engine part of the problem, and to deal only with the problems which relate to the electrical design and construction.

I cannot conclude without saying how much I have been impressed, in arranging the matter for these lectures, with the extreme sagacity, as well as the genius and tenacity

of purpose, of Mr. Parsons in fighting his way not only through the steam problems of the turbine, but also through the electrical problems, and I feel that I have not been able to do adequate justice to his many and great achievements. All honour to the pioneers.

Finally, I have to acknowledge gratefully the co-operation of a large number of firms, whose names I have already mentioned, in giving me, very liberally, information, photographs, drawings and data that have been perfectly invaluable. I have to thank these various firms for their courtesy, and I have also to record with gratitude the services of my assistant, Mr. H. W. Taylor, in collating data, and lightening my labour in various ways.

CHINA SHOE TRADE.

It is estimated that the lower classes in China expend about six shillings and threepence a head per annum for shoes, while the expenditure of the upper classes varies from twelve shillings and sixpence to over two pounds per annum. With a population of 400,000,000, China presents an inviting field for boot and shoe manufacturers, according to a recent report by the American Special Agent in that country. The expenditure for the native-made boots and shoes of China reaches enormous proportions annually, but as yet there has apparently been no systematic effort on the part of foreign manufacturers to enter the field, and the market is expanding steadily because of the constantly increasing purchasing power of the Chinese. Chinese boots and shoes are made by the cheapest labour in the world, but it must be remembered that in the manufacture of the enormous quantity required, no machinery of any kind whatsoever is used. The consequence is that while there is a certain necessary uniformity observed in the cut and pattern, the work is slow, the workmanship poor, and the quality of the materials used unserviceable. It is, in the opinion of the Special Agent, only fair to assume that if the natives of China could be supplied with boots or shoes made in exact accord with the styles popular throughout the Empire, possessing the advantages of better material and workmanship and greater durability, the consumers would welcome their introduction if the prices were satisfactory. The shoes worn by the natives are made with leather or cotton-cloth soles, above which is a layer of rags, or paper, or feathers with cotton cloth next to the foot. The uppers are made of cotton sheetings or shirtings, Italian cloth, satins or velvets, dyed either black or blue. Women are employed to sew together the uppers, which are cut by the shoemaker. After that work has been completed, the uppers are returned to the shoemaker, who attaches the sole, and the shoes are then ready for distribution through the native dealers. The women's shoes are those worn by the so-called "reformed ladies," a class whose numbers are constantly increasing, because of emancipation from the cruel custom of binding the feet. In Northern China shoes are also universally in use during the warm weather, but with the advent of winter it is the practice of the Chinese to wear what may be called the Chinese boot. This is also made of cotton sheetings, shirtings, velvets or satins dyed either black or blue. The leg of the boot which extends about halfway to the knee, is sufficiently large to hold the trousers. The boots have either a leather or a cotton cloth sole, with a layer of paper, rags, or feathers above and cotton cloth next to the foot. A stiff but inexpensive material is used as a lining to hold the leg of the boot in an upright position, and on the outside is the covering of velvet or cotton cloth as the case may be. Machinery could be utilised in cutting out the material for boots quite as easily as for shoes. It seems capable of demonstration that a large market will eventually be developed for what may be termed army boots. These boots are cut on the same pattern as those for ordinary wear, but are made mostly of leather. The soles consist of two pieces of thin leather with a third piece inserted at the heel to give a spring while walking. Above this is a layer of rags or paper, and cotton cloth is placed next to the foot. Smooth, well tanned leather, presumably imported, is used, and like all other footwear used by the natives of China these boots are hand-made. In the recent army manœuvres near Tientsin it was estimated that there were 60,000 Chinese troops in the field. This was regarded as the nucleus of a standing army which the Empire proposes to maintain in the future. The size of this army it is obviously impossible even approximately to estimate, but it may be safely assumed that it will be sufficiently large to make a calculation as to the minimum number of pairs of boots that will be required, and the amount that will be expended therefore annually, both interesting and instructive to manufacturers. In conclusion, the Special Agent says:—"The importance of an immediate investigation of this market by an expert cannot be too strongly emphasised. If his knowledge of the cost of production, transportation, handling, and incidental expenses, convinces him that boots and shoes, similar in all respects to those now used in China, could be laid down there at a price comparing favourably with that now paid, no time should be lost in introducing them. It may be set down as an incontrovertible fact that, in the opening up of a market in China for new goods, of whatever description of foreign manufacture, the first 'chop' or trade mark in the field meeting the tastes, the requirements, the whims, the prejudices, and the purchasing power of the natives, will become so firmly established and so popular that subsequent attempts to dislodge it by competing nations will be a long, tedious, and in all probability an unsuccessful task."

HOME INDUSTRIES.

Railways and Wages. — It is much to be hoped that the agitation amongst the railway workers for shorter hours and higher wages will be adjusted without acute conflict. Roughly there are 600,000 railway servants in the country, and they want to raise the present average wage from 25s. per week to 27s. 6d. That would cost £3,900,000. Then they want shorter hours, which would necessitate the employment of an additional 50,000 men, at a cost of £3,575,000, so that if the full demands of the men were conceded the railway companies would have to face an additional expenditure of £7,475,000 per annum. It is not likely that there will be any such general rise as that involved in the complete acceptance of the demands of the men, but it may be taken as probable that there will be increase in certain directions. Indeed the North-Eastern and the Scottish companies have already made concessions. An all-round rise in wages must depend upon the general prosperity of the country, and if that increases as it bids fair to do, the railway companies must meet the men half way, or many of them will seek more remunerative employment. And of course active trade means large expansion in the gross earnings of the railways from which the entire cost of service would be taken. Meantime, and irrespective of the expansion of trade, the locomotive engineers would seem to have the strongest claim to better wages. They are driving more powerful and economical engines than in the past, the one meaning greater strain and the other saving in cost of working, and it would seem reasonable that certain benefit should accrue to them. No class in the community of workmen has more responsible or exacting duties to the public, and none performs them more faithfully. And whilst increased efficiency is hardly possible amongst the locomotive engineers increased pay of railway servants generally, as of others, should mean increased efficiency. There is little reason to fear that the companies and their men will fail to reach an agreement upon the wages question. Cessation of work consequent upon inability to agree would be lamentable for all concerned, and neither directors nor workmen are likely to forget it.

The Strike on the Clyde. — Whilst differences between railway *employés* and servants will probably be adjusted, the shipyard workers on the Clyde have decided to strike for higher wages. The conference recently held failed to bring about a settlement, and the executive council of the United Society of Boiler Makers and Iron and Steel Shipbuilders therefore intimated to the Federated Shipowners that they had approved of the men ceasing to work on the 29th September, unless the employers agreed to arbitrate immediately, which they refused, although they were willing to discuss the question in December. The men have therefore come out. Some 7,000 men are immediately affected, but if the quarrel continues a very much larger number must be implicated. Shipwrights, carpenters, joiners, sawyers, and other trades connected with the construction of the hull of a ship will have to suspend labour, and if hulls are not constructed, marine engines, pumps, and the like, will not be wanted. The position is a very difficult one, and the outlook very serious. The case for the boilermakers is that the men have had two reductions, each of 5 per cent., within the past two years, and that they have worked all through a period of exceptional prosperity at the rates of depressed times. Promised that when trade improved their claim for an advance would be considered, they have been put off from time to time until trade has begun to go back, when the employers plead depression as excuse for further reduction. On the other hand, the employers contend that the diminishing quantity of work on hand cannot afford an increase in wages, and that an increase in labour costs would prevent builders obtaining any more orders for new ships, so that they cannot afford to arbitrate. If the award went against them they would simply have to close their yards. Moreover, they object to intervention by third parties in their relations with their *employés*. Whatever may be said of the men's contention as to reductions in the past, there can he no question whatever that the present outlook for the shipbuilding industry, apart from labour troubles, is bad. There has been an immense production of tonnage during the year, and a good deal remains to be completed, but new orders are not coming in. It must be remembered too, as Sir Charles McLaren pointed out the other day, that the shipbuilding industry has been greatly disadvantaged by the high price of iron and steel which, with other circumstances, "make it extremely difficult and almost impossible for shipbuilders to obtain contracts which show any profits upon estimates." Probably this fact has weighed less than it should have done with the men. They have seen the yards full, and orders coming in one upon another, which have led to an unprecedented output of tonnage, and they have concluded that the employers were reaping a rich harvest in the way of profit upon construction when, in fact, the price of materials has often left little or no profit. But there has been no strike of shipyard workers on the Clyde for many years, and the younger men, without personal knowledge of the miseries of earlier labour wars, seem to be indisposed to listen to cautious counsels.

Freights.—A glance at the freight list serves to recall the great reduction in water carriage during the last thirty years. Take coal freights from Cardiff. For Genoa, the current price at the time of writing these Notes, remains at about 6s. for handy tonnage. In 1872, the rate was 17s. 3d., taking the average of the last six months of the year as given by the circulars of Tellefsen, Holt, and Wills. Port Said charterers are filling their requirements at 5s. against 19s. 6d. in 1892, while Alexandria have been fixed from 5s. 9d. to 6s. 6d½. as against 18s. 6d. For Colombo again

charters have been effected at 11s. 7½d. for the end of October as against 24s. in the earlier year. The 5s. freight from Cardiff to Port Said, a distance of over 3,000 miles, is less than the cost of conveying coal by rail from the Rhondda Valley to London, a distance of only 170 miles, or Liverpool, or Southampton. The land carriage by rail over the Great-Western works out at about 0·40d. per ton per mile, or 0·44d. with waggon hire, as against a little over 0·02d. per water carriage to Port Said. Or to put it in another way the cost of carriage per ton per mile by rail is about twenty times that by water. ifty tons of coal can be carried a mile by water for 1d. as against 2½ tons by rail, and say 2 cwt. by horse and cart along a high road. The result of this low water carriage is that the cost of Welsh coal to the foreign trans-atlantic and other passenger steamers is no greater than that to British liners, and that the Egyptian railways get their supply of fuel as cheap, if not cheaper, say, than the Brighton or South-Eastern.

The Hop Crop.—Hop picking is now over and the results confirm the unfavourable estimates of mid-summer. It is believed that the crop will be the smallest since that of 1882, but whereas in that year the price went up to £21 2s. per cwt. there is little likelihood of anything like this price being reached this year. It is true that the later advices from the Pacific coast state that the yield is turning out at far under recent expectations, and it is natural that growers should be unwilling to sell near the present basis of value of £6 or £8. Nor is there any reasonable doubt that prices will be very much higher later in the season, but last year's crop was as large as the present one is small, and it is believed that brewers are holding large stocks over from last year, which is naturally affecting prices. A short crop does not necessarily mean a poor profit. On the contrary it is in the short cropping years that the losses of other years are often made up. Given fair average prices, and the reduction in the cost of picking on a small crop, as compared with one like that of last year, is so great that the crop may be much more profitable than a very large one which means immense expenditure on picking, and low prices. And unfortunately this year growers were put to exceptionally heavy expense in coping with the blight. Taken as a whole the present crop can hardly be other than a disastrous one for growers, and the effect upon acreage is likely to be severe unless the market improves to a point which at present is unlikely.

Excise and Whisky.—The returns of amounts paid into the Exchequer in the six months ended September 30, show under the head of Excise a decline of £133,000, or from £14,440,000 to £14,307,000, or taking only the last three months, of £220,000, as from £7,640,000 to £7,420,000. It would seem from these figures that the sobriety of the nation continues to grow, for it must be remembered that the population is still growing at about the rate of 1 per cent. per annum, and the wealth of the country at over 3 per cent. per annum, taking one year with another. But it is too soon to assume it to be proved that the nation is becoming more temperate, that the substantial diminution in the consumption of beer and spirits in the last six years points to a permanent condition of affairs. If the history of the last fifty years is taken, it points rather to consumption of beer and spirits depending mainly upon prosperity or the contrary rather than the spread of temperance. In 1852, when the country was beginning to enjoy that remarkable period of industrial prosperity which was such a striking feature of the second half of the nineteenth century, the clearings of beer *per capita* amounted to 21·89, and the total consumption was only 16,732,454 gallons: twenty years later the clearings had risen to 31·86 gallons *per capita*, and the total consumption to 28,171,661. Then followed a period of trade depression, and the clearings *per capita* fell to 27·63 in 1882, and to 26·90 in 1886. Then came a revival of prosperity, and in 1892 the clearings *per capita* had risen to 29·75, and in 1899 to 32·53. After that year the consumption steadily receded, until in 1905 it had fallen to 27·42. It was much the same with spirits. In 1863 the clearings *per capita*, proof gallons, were ·83; in 1875 they reached 1·27, to fall away to ·93 in 1887, recovering to 1·12 in 1900, since which, as with beer, there has been steady decline to ·91 in 1905. But even now the people of this country drink considerably more beer and spirits per head than they did fifty years ago. Now that business is good again will there be recovery in consumption? The Excise returns of the three months just ended would seem to point to a negative reply. On the other hand, the clearing of beer for consumption for the six months ended June 30 last amounted to 16,124,261 barrels as against 15,885,908 in 1905, and of spirits, 18,312,732 gallons, as against 18,244,717 in 1905, which, having regard to the increase of population, indicates practically a stationary consumption. It may be possible to make more confident deductions as to the trend of consumption a year hence.

The Coal Trade.—In the absence of untoward circumstance it is almost certain that the coal production of the United Kingdom in 1906 will considerably exceed that of any previous year. In the eight months ended August 31 last, we exported 36,569,442 tons of coal as compared with 31,180,138 tons in the corresponding period of 1905. Our total exports of coal, coke, and patent fuel amounted to 38,029,362 tons as against 32,371,451 tons, or if the coal supplied to bunkers of steamers in the foreign trade is added the total sent away reached 50,333,448 as against 43,825,410 tons. The supply to steamers in the foreign trade is not, of course, an increase in exports, but it indicates the depletion of German coal. The increases in actual exports are chiefly to Russia, Sweden, Belgium, France, and Italy; the exports to Germany, 4,928,079 tons, as against

5,071,155 tons, showing a slight decrease on the eight months, although in August there was an increase from 657,836 tons to 759,456 tons. Partly because of the interruption of her production by strikes in the early part of last year, and partly owing to the increased consumption in her own domestic requirements, Germany has been unable to keep up her seaborne export trade and the United Kingdom has been the gainer. Notwithstanding the large home industrial consumption of coal, and the exceptional export demand, the absence of trade disturbances in the way of strikes, and the like, has enabled production to be so well maintained that hitherto supply has been adequate to meet demand, and there has been no serious increase in prices, not more than from 6d. to 1s. per ton on last year. The export duty of 1s., which has helped Germany so much to develop her seaborne export trade, will soon be removed, to the advantage of the British exporter. But for the scarcity in Germany there would be a larger supply and lower prices in our home markets, but Germany is not likely to have much surplus coal to sell for some time to come. It is astonishing how British shipments to Russia have been maintained and increased notwithstanding the internal disorders in that country. For the eight months ended August 31, 1905, the United Kingdom sent Russia 1,612,681 tons of coal, for the corresponding period of this year the export was 1,965,849 tons. The immediate outlook for the coal trade is good, and the output may be expected to continue to increase for some time to come. It may be noted that the Northumberland miners, who have previously always opposed, have recently passed a union vote in favour of a compulsory eight hours' day, but that is a regulation not likely to be sanctioned by Parliament this year or next.

GENERAL NOTES.

School of Art Wood-carving.—The School of Art Wood-carving, South Kensington, which now occupies rooms on the top floor of the new building of the Royal School of Art Needlework in Exhibition-road, has been re-opened after the usual summer vacation. Some of the free studentships maintained by means of funds granted to the school by the London County Council are vacant. The day classes of the school are held from 10 to 1 and 2 to 5 on five days of the week, and from 10 to 1 on Saturdays. The evening class meets on three evenings a week and on Saturday afternoons. Forms of application for the free studentships and any further particulars relating to the school may be obtained from the manager.

Openings for Trade in China.—In his report on the trade of Changsha (Cd. 2682) Mr. Acting-Consul Giles refers to the intention of the Chinese authorities to open to foreign trade the two great commercial centres of Hunan and Siangtan and Changtê, and predicts that once these places are open and have been made accessible to steamers all the year round, the foreign trade ot the province will increase very rapidly. This applies especially to Changtê, the wealthiest and most important trade mart in Hunan, and at the same time the least easy of access. At present, junks proceeding from Yochow to Changtê, make the detour round the south of the Tungting lake, but this route is not suitable to steamers, being far too narrow and winding, as well as exceedingly shallow in places. There is a channel across the lake which, after being dredged in places, and buoyed throughout, would be available for light draught steamers all the year round, but the Chinese authorities show no signs of taking any steps to improve this channel. On the other hand, steamers already run regularly to Siangtan under the Inland Steam Navigation rules; though the shallowness of the river during the low-water season prevents them from plying for more than nine months in the year.

Calcutta Botanic Gardens.—In his report for 1905-6, Captain Gage, M.B., Acting Superintendent of the Royal Botanical Gardens, Calcutta, gives an account of the distribution of economic plants throughout India. In India there has been a revival of interest in rubber, and not a few applicants have been furnished with information and seed or plants of *Ficus elastica* and *Manihot Glaziovii*. The latter, which yields Ceara rubber, appears to thrive in Bengal and Assam, but it is doubtful whether it yields rubber equal to that obtained from the same species cultivated in Southern India and Ceylon. Camphor-seed has been supplied to certain parties. Sisal hemp plants have been distributed to certain gaols, and lime-seeds as usual to many of the gaols in Bengal. Seeds of timber and other useful trees have been largely distributed over India and to other tropical or semi-tropical countries. Outside of India seeds of the species of *Aeschynomene* which furnishes "Sola" pith were supplied to the Jardin Colonial of Paris; collections of economic bamboos and of seeds of useful Indian trees were distributed to the Honourable Joseph Baynes, C.M.G., and Mr. Charles Hitchins of Natal—who had both personally visited the garden last year—for attempted acclimatisation in South Africa; deodar seed was supplied to the Transvaal Landowners' Association, and jute seed to the Government of German New Guinea; seed of "Sunn" hemp was distributed to the United States Agricultural Department in the Philippines, and indigo seed to the Dutch Agricultural Department in Java, and to a correspondent in the Ile de la Reunion; tea seed was sent to the Agricultural Association of the Island of Sicily. The economic additions to the garden include Caravonica cotton; a collection of grasses from the Transvaal Agricultural Department; a similar collection from the United States Department of Agriculture; and a collection of economic plant seeds from the Estacion Agronomica of Havana.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

PROCEEDINGS OF THE SOCIETY.

THE EXAMINATIONS OF 1906.

The Examinations this year were held at 390 centres in the week commencing April 2nd, and lasted from the Monday until the following Friday.

The Commercial subjects included, as usual, Book-keeping, Accounting and Banking, Shorthand, Type-writing, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages. The other subject of examination was Music, divided into Rudiments of Music and Harmony.

The only alteration of any importance was in the Shorthand Examination. Formerly all the different stages of Shorthand were taken on the same evening. The different stages this year were taken on two evenings, and some changes were made in the different speeds, which were:—Advanced, First-class 150, Second-class 120 words per minute; Intermediate, First-class 100, Second-class 80 words, and Elementary 50 words. The speed for the First-class of the Advanced stage will be reduced next year to 140, the number at which it previously stood, as it seems to be the opinion of many teachers that 150 is unnecessarily high.

Swedish was added to the list of subjects in Stages II. and III., and the examination in Danish was changed to Danish and Norwegian.

After the issue of the 1905 prize lists, a strong protest was addressed to the Council by the committees of certain centres urging that there should be an age limitation for prize winners, and that neither teachers nor professionals should be eligible for prizes. The matter was very carefully considered by the Examinations Committee, by whose advice the Council issued a notice to the effect that no prize or medal in any subject would be awarded to any teacher of that subject, or to any person over the age of 23 whose profession or occupation was connected with the subject, unless he or she had been a regular attendant at a class for instruction during the twelve months preceding the date of examination.

The object of this was to exclude professional competitors without placing any hindrance in the way of genuine students, who might yet be engaged as shorthand clerks or typists, or in some similar capacity. The rule was intended to come into force at the examinations in April, but the Council felt that its strict enforcement might bear hardly on some candidates who possibly had not been aware of its existence, since it was issued after the publication of the 1906 Programme. Additional prizes and medals were therefore awarded in several cases where the candidates would have been disqualified under the new rule. In next year's examinations, it is unnecessary to say, the regulation will be strictly enforced.

The Society this year awarded 31 Silver and 39 Bronze medals, the former in the Advanced Stage and the latter in the Intermediate. They also gave away money prizes to the value of £115, besides other prizes amounting in all to £20, provided annually by the liberality of the Clothworkers' Company. This year the prize fund has been assisted by the generous donations of £50 from the Goldsmiths' Company, and £5 5s. from the Skinners' Company.

The total number of candidates at the examinations of 1906 was 21,359 (Advanced, 4,362; Intermediate, 9,572; Elementary, 7,425). This is an increase of 106 upon the 21,253 candidates of 1905. The number of papers worked by these candidates was—Advanced, 4,904; Intermediate, 10,097; Elementary, 8,537. In addition to this there were 637 candidates examined in Music at the same time as those in the Commercial subjects.

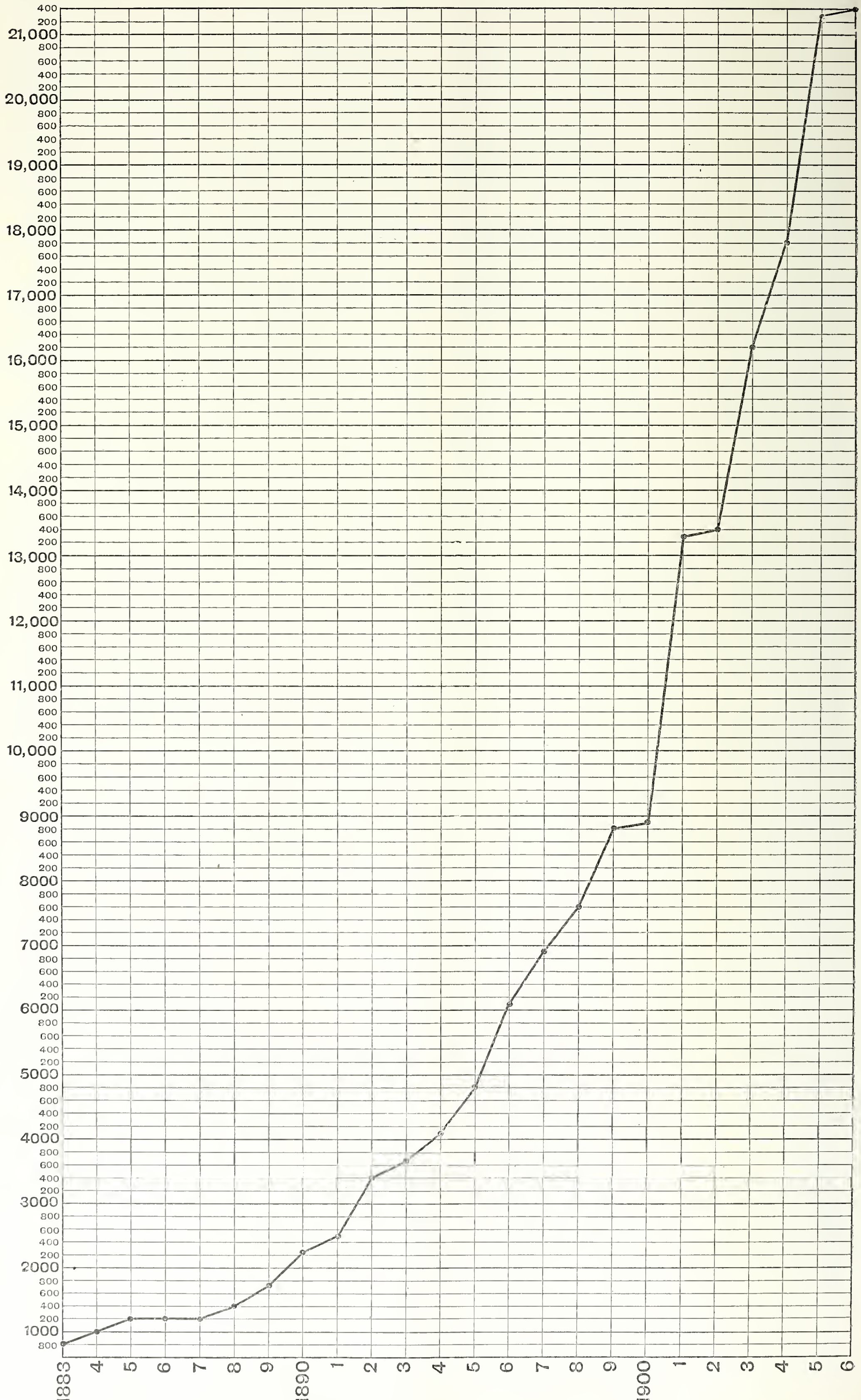


Diagram Showing Progress of Examinations, 1883 to 1906.

TABLE SHOWING THE DETAILED RESULTS OF THE 1906 EXAMINATIONS HELD AT 390 CENTRES.

Subjects.	Stage III.—Advanced.				Stage II.—Intermediate and Music.							Stage I.—Elementary.		
								Music Certificates.						
	Papers worked.	1st class certificates.	2nd class certificates.	Not passed.	Papers worked.	1st class certificates.	2nd class certificates.	Higher.	Inter-mediate.	Elemen-tary.	Not passed.	Papers worked.	Passed.	Failed.
Arithmetic	119	28	51	40	512	56	262	..	..	..	194	851	457	394
English	52	8	25	19	282	46	162	..	..	..	74	..	..	..
Book-keeping	2,088	215	1,120	753	3,485	678	1,948	..	..	..	859	2,589	1,451	1,138
Commercial History & Geography	31	6	10	15	51	6	27	..	..	..	18	..	..	..
Commercial Geography	..	..	..	..	..	..	..	..	..	..	..	139	96	43
Shorthand	783	41	330	412	3,486	901	1,242	..	..	..	1,343	2,218	1,248	970
Typewriting	363	69	172	122	780	159	371	..	..	..	250	810	596	214
Economics	47	10	24	13	59	9	31	..	..	..	19	..	..	..
Précis-writing	84	19	31	34	154	44	56	..	..	..	54	..	..	..
Commercial Law	224	23	118	83	..	..	..	..	..	..	..	..	..	..
Accounting and Banking	322	43	179	100	..	..	..	..	..	..	..	..	..	..
French	491	92	249	150	872	118	472	..	..	..	282	1,006	672	334
German	167	35	84	48	268	43	133	..	..	..	92	299	177	122
Italian	16	7	6	3	30	10	14	..	..	..	6	32	23	9
Spanish	89	20	38	31	82	21	46	..	..	..	15	68	52	16
Portuguese	17	9	6	2	7	3	2	..	..	..	2	..	..	..
Russian	5	1	4	..	9	1	5	..	..	..	3	..	..	..
Danish and Norwegian	4	3	1	..	5	1	3	..	..	..	1	..	..	..
Swedish	2	2	..	..	10	1	3	..	..	..	6	..	..	..
Japanese	..	..	..	..	5	..	..	..	..	..	5	..	..	..
Handwriting and Correspondence	..	..	..	..	..	..	..	..	..	..	..	525	298	227
Rudiments of Music	..	..	..	..	406	..	..	161	..	172	73	..	..	..
Harmony	..	..	..	..	231	..	..	17	47	111	56	..	..	..
Totals	4,904	631	2,448	1,825	10,734	2,097	4,777	178	47	283	3,352	8,537	5,070	3,467

In addition to these again there were 644 candidates in Colloquial Modern Languages, and 467 in the Practice of Music. The total number of candidates who were examined in all subjects by the Society of Arts during the year ending July last, was therefore 22,470.

The progress of the examinations since 1883, when they were re-organised and a fee was first charged, down to the present year, is shown graphically in the diagram on page 1066. The detailed results of the three stages are shown in the Table on page 1067, and the numbers of papers worked in each subject in 1905 and 1906 in the Table above.

The total numbers show but a trifling advance upon last year. The new system introduced in 1905 resulted in a very large increase, from 17,771 in 1904 to 21,253 in 1905. This year the growth is but trifling, to 21,359. Taking the number of papers worked, we find in the two upper stages a total of 15,001 this year, against 14,837 last, the proportionate increase being the same in each stage, 60 in the Advanced with 4,904 papers, and 104 in the Intermediate with 10,097 papers. In the Elementary stage 8,427 papers were worked, an increase on last year of 110.

In Stages II. and III., Book-keeping is still the most popular subject with 5,573 candidates, Shorthand being as usual, second with 4,269. French, which it is satisfactory to note has been steadily growing in popularity of late years, now takes the third place with 1,363 papers, Typewriting, with 1,143, being fourth. None of the other subjects reach such large figures. 631 candidates took up Arithmetic, 435 German, 334 English, 322 Accounting and Banking, 238 Précis-writing, 224 Commercial Law, and 171 Spanish. None of the other subjects reached three figures. Hindustani, for which, when it was introduced last year, there were two candidates, attracted none this year. There were 12 for the new subject of Swedish.

In the Elementary Stage the 7,425 candidates worked 8,537 papers, so that, as is

Number of Papers worked in each Subject in 1905 and 1906.

Subjects.	1905.			1906.		
	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.
Arithmetic	154	360	514	119	512	631
English	83	235	318	52	282	334
Book-keeping	1,869	3,899	5,768	2,088	3,485	5,573
Commercial History and Geography	48	54	102	31	51	82
Shorthand	1,010	3,343	4,353	783	3,486	4,269
Typewriting	375	933	1,308	363	780	1,143
Economics	48	33	81	47	59	106
Précis Writing	105	104	209	84	154	238
Commercial Law	169	..	169	224	..	224
Accounting and Banking	208	..	208	322	..	322
French	441	657	1,098	491	872	1,363
German	180	262	442	167	268	435
Italian	21	12	33	16	30	46
Spanish	94	80	174	89	82	171
Portuguese	28	6	34	17	7	24
Russian	7	10	17	5	9	14
Danish and Norwegian	4	..	4	4	5	9
Hindustani	..	2	2	..	..	..
Swedish	..	..	..	2	10	12
Japanese	..	3	3	..	5	5
Totals	4,844	9,993	14,837	4,904	10,097	15,001

always the case, a large proportion of the candidates in this, as in the higher stages, were content with a single subject. Book-keeping attracted the largest number, 2,589; next was Shorthand, 2,218, against 1,819. The next largest subject was French, for which there were 1,006, a considerable increase on any previous year. Then comes Typewriting, for which 810 candidates presented themselves. In Arithmetic there were 851 this year; in Handwriting and Correspondence 525. In German the numbers were 299, Spanish 68. In Commercial Geography 139 candidates entered. Italian attracted 32 entries. In all 5,070 certificates were granted to successful candidates, and there were 3,467 failures.

The general character of the results, and the manner in which the various subjects were dealt with, may be estimated from the following Tables, which show the percentages of failures and successes in all three stages in this year's and in last year's examinations, and similar percentages for all the subjects in the two upper stages for the present year. The number of entries in some of the smaller subjects is insufficient for such calculations to have much value, but the percentages are given for the sake of completeness:—

Percentages of Successes and Failures in all Stages 1905 and 1906.

	1905.		1906.
Advanced (Stage III.):—			
First-class	14·2	..	12·86
Second-class	51·	..	49·92
Failures	34·8	..	37·22
Intermediate (Stage II.):—			
First-class	17·	..	20·77
Second-class	50·4	..	47·32
Failures	32·6	..	31·91
Elementary (Stage I.):—			
Passes	57·	..	59·39
Failures	43·	..	40·61

From these figures it appears that there was a slight falling off in the standard of the Advanced candidates, and this may probably be accounted for by the fact that in 1905 a good many holders of Society of Arts certificates, granted under the old system, were attracted by the new Advanced certificate, given last year for the first time. The Intermediate Stage shows a higher percentage of First-classes, and a lower percentage of failures; the percentage of Second-classes is a little less than last year. The Elementary Stage also shows progress, with a higher proportion of passes and a diminished proportion of failures.

Percentages of Successes and Failures, Advanced Stage, 1906.

	First-class.	Second-class.	Failures.
Arithmetic	23·53	42·85	33·62
English	15·4	48·1	36·5
Book-keeping	10·3	53·6	36·1
Commercial History and Geography	19·35	32·25	48·4
Shorthand	5·24	42·16	52·6
Typewriting	19·01	47·38	33·61
Economics	21·28	53·19	25·53
Précis-writing	22·62	36·9	40·48
Commercial Law	10·27	52·67	37·06
Accounting and Banking	13·35	15·59	31·06
French	18·75	50·7	30·55
German	21·0	50·3	28·7
Italian	43·75	37·5	18·75
Spanish	22·48	42·69	34·83
Portuguese	53·0	35·3	11·7
Russian	20·0	80·0	0·0
Danish and Norwegian	77·7	22·3	0·0
Swedish	100·0	0·0	0·0

Percentages of Successes and Failures, Intermediate Stage, 1906.

	First-class.	Second-class.	Failures.
Arithmetic	10·93	51·18	37·89
English	16·31	57·44	26·25
Book-keeping	19·44	55·85	24·71
Commercial History and Geography	11·8	53·0	35·2
Shorthand	25·85	35·63	38·52
Typewriting	20·38	47·70	31·92
Economics	15·25	52·55	32·2
Précis-writing	28·57	36·36	35·07
French	13·55	54·12	32·33
German	16·04	49·63	34·33
Italian	33·34	46·66	20·0
Spanish	25·61	56·1	18·29
Portuguese	42·86	28·57	28·57
Russian	11·11	55·55	33·34
Danish and Norwegian	20·0	60.0	20·0
Swedish	10·0	30·0	60·0
Japanese	0·0	0·0	100·0

Appended are some extracts from the Examiners' reports on the various subjects:—

English.

Stage III.

Comparatively few candidates attempted the Advanced papers this year; those who did acquitted themselves fairly well, in a few cases brilliantly.

The evidences of ability in the papers were more

striking than those of study, coming out particularly in the style and treatment of the essays, and in the application of "mother wit" (as distinct from "clergy") in the explanation of English idioms. The knowledge of the history of our language shown was small. Not a single candidate explained the origin of the initial *N* in the familiar abbreviation for *Edward.* Scarcely anyone could tell the marks by which words in English of Latin origin, introduced through mediæval French, or those by which words of Scandinavian origin, may be distinguished. The paraphrasing was done better than last year, though the meaning of the first few lines of Ulysses' advice to Achilles (in "Troilus and Cressida") was grasped only by a few. In the answers on literature it was surprising to find such worthies as Andrew Fairservice and Alan Breck pass generally unrecognised. Are Scott and Stevenson not in favour with our candidates?

Stage II.

The statistics compare very favourably with those of last year, when, out of 235 candidates, only 14 obtained a First-class certificate, and as many as 82 did not pass.

The improvement seems due in the main to more careful preparation on the part of the candidates, and not to any decrease of difficulty in the paper set.

The grammar section was well managed by a large number, with the exception of the question on adjectives, a part of which dealt with certain usages in English which had escaped general notice. In the passage for analysis a clause not fully expressed was left out of consideration by most of the candidates; and a large number mistook what was required in the last part of the fifth question, for a full answer to which only a few short words were needed.

The section on composition showed less advance upon last year than the grammar. The punctuation was fair, and the essays, in great part, were satisfactory, the subject most in favour being "The Problem of Unemployment." On "The Wonders and Uses of the Microscope" there were some admirably written compositions. The alternative of writing a business letter instead of an essay was this year chosen by few. In the definitions of terms there was much deficiency. Very few indeed could explain what a "periodic sentence" is; "climax" was defined by many merely in its popular sense of "culmination"; the true nature of a "simile," as distinct from a mere exemplification, was rarely brought out.

BOOK-KEEPING.

Stage III.

The number of candidates this year was 2,088, as against 1,869 in 1905. The results have not been quite so satisfactory as last year; this no doubt is accounted for by the fact that many capable men seized the first opportunity afforded of passing this advanced examination.

Working to the Society's percentage standards of necessary pass marks, I have to report that of the above 2,088 candidates, 1,335 (63·91 per cent.) have passed, and 753 (36·09 per cent.) failed, being distributed thus:—

First-class	215	....	10·28 per cent.
Second-class ..	1,120	....	53·63 ,,
	1,335		63·91 ,,
Not passed	753	....	36·09 ,,
Total	2,088	....	100·00 ,,

Compared with 1905, the result is:—

Year.	No. of Candidates.	Percentage of Passes.	Percentage of Failures.
1905	1,869	68·65	31.35
1906	2,088	63·91	36·09

Comparing the detailed results similarly, we have:—

Year.	1st Class.		2nd class.		Not passed.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
1905	262	14·02	1,021	54·63	586	31·35
1906	215	10·28	1,120	53·63	753	36·09

The Medals and Prizes have been well earned.

Stage II.

The number of candidates this year was 3,485, as compared with 3,899 in 1905, or a falling off of 414. I do not propose, this year, taking my comparison further back, as changes last year, both in stages and standards, would render such a comparison somewhat misleading.

I have to report that of the above 3,485 candidates, 2,626 (75·29 per cent.) passed and 859 (24·71 per cent.) failed, being distributed thus:—

First-class......	679	....	19·44 per cent.
Second ,, ...	1,948	....	55·85 ,,
Together ..	2,626	....	75·29 ,,
Failed	859	....	24·71 ,,
Total	3,485	....	100·00 ,,

Comparing the above with last year's results we have:—

Year.	No. of Candidates.	Percentage of Passes.	Percentage of Failures.
1905........	3,899	73·61	26·39
1906........	3,485	75·29	24·71

Comparing the detailed results similarly, we have :—

Year.	1st Class.		2nd Class.		Failed.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
1905....	687	17·62	2,183	55·99	1,029	26·39
1906....	678	19·44	1,948	55·85	859	24·71

It will be seen that the results are a little better than last year both as to the increase in the First-class and in the percentage of failures; while the percentage of Second-class men remains practically stationary. Of the 859 failures, 97 obtained fewer than 20 per cent. of marks or 2·78 per cent. of the total candidates. On the whole I consider the result decidedly good.

The medals and prizes have been well earned. No candidate has obtained full marks.

Stage I.

This year the entries have been 2,589, of which 1,451 have passed and 1,138 failed. Comparing this result with the previous four years we have :—

Year.	Passed.		Failed.		Total.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
1902....	884	58·82	619	41·18	1,503	100 00
1903....	1,017	60·39	667	39·61	1,684	100 00
1904....	1,422	62·23	836	37·77	2,285	100·00
1905....	1,370	51·72	1,279	48·28	2,649	100·00
1906....	1,451	56·04	1,138	43·96	2,589	100·00

It will be seen that the result, as a whole, is a little better than last year; and it must be borne in mind, when comparing the percentages of failures with other examinations, that it is necessary in this case to obtain half marks in order to pass—a very salutary provision in a preliminary examination, but one naturally adversely affecting the percentages.

The relative position of the candidates who have failed as to competency is shown in the following Table :—

I give the following answers to Question I. as samples of many curiosities found in the papers, and showing how much many of the young people have to learn :—

Question I. Briefly explain the following terms and abbreviations :—"Assets."—"A person's assets are what he owes. If a merchant's assets exceed his liabilities, he is said to be insolvent, that is, he cannot pay his debts." "Contra a/c."—"The amount payed out of a business; used instead of asset on a three-*collumed* cash-book." "Personal ledger."—"The owner of the business is the personal ledger." "E. & O. E."—"English and old English." "N.B."—means "debit my a/c." Another, "Note abene, which means, take particular notice of."

Commercial History and Geography.

Stage III.

The number of candidates was more than thirty per cent. less than last year, and, unfortunately, this number included a large proportion who have still failed to realise the standard that must be required for such an examination, and a considerable proportion who ought not to have been entered even for the Intermediate Stage. The papers worked by these last showed little real study, and betrayed the idea that hasty impressions derived from the newspapers might suffice to meet the requirements. Even in some papers of a better type the answers to the fourth question, on the geographical conditions affecting certain towns at different times, were often merely of the kind that might be expected in the Elementary Stage, and not good even for that stage. Candidates who can write down the literally preposterous statement that Lübeck owed its importance in past times to its being the Head of the Hanseatic League may rest assured that they have not grasped the meaning of geographical influences. But in spite of all that remains to be desired, this examination was in some respects highly satisfactory. Several of the papers were of a high degree of excellence under every head, and well earned the marks that they obtained, ranging up to 86 per cent. of the total.

Percentage of marks obtained.	No. and Percentage of Candidates.									
	1902.		1903.		1904.		1905.		1906.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
From 0 to 9	29	1·93	7	·41	19	·83	36	1·36	12	·46
,, 10 to 19	76	5·05	23	1·37	50	2·19	82	3·10	39	1·51
,, 20 to 29	130	8·65	69	4·10	83	3·63	179	6·76	156	6·03
,, 30 to 39	193	12·84	160	9·50	248	10·86	389	14·68	404	15·60
,, 40 to 49	191	12·71	408	24·23	463	20·26	593	22·38	527	20·36
Failed	619	41·18	667	39·61	863	37·77	1,279	48·28	1,138	43·96
Passed............	884	58·82	1,017	60·39	1,422	62·23	1,370	51·72	1,451	56·04
Total	1,503	100·00	1,684	100·00	2,285	100 00	2,649	100·00	2,589	10·000

Stage II.

The number of candidates was slightly smaller than last year. Much of the work was good, some of it even very good; but a considerable proportion of the candidates appear to have entered for the examination absolutely without special preparation, and served up merely wild guesses in answer to the questions on the Orient. Among the papers entitled to serious consideration, the first question—on the influences of mountains on rainfall and temperature—was, on the whole, the least satisfactorily answered. Too often the answers did not keep strictly to the point. All climatic conditions of the parts of the world referred to in the question were described. Even in the answers that were throughout relevant, there was hardly any reference to seasonal distinctions in the climate. Marks were often lost in the answers to the second question—on countries importing and exporting iron ore—by the candidates not answering the question as put, but giving information about the production of iron ore, or the export of iron or iron manufactures.

Stage I.

The number of candidates this year was more than 40 per cent. in excess of the number who presented themselves last year, and the work done was, on the whole, satisfactory. The proportion of failures, about 31 per cent., was smaller than last year, and many exceptionally good papers were received from those who got beyond the pass limit, one paper gaining 99 per cent. of the marks. The most general fault was the same as that to which attention was drawn in the report of last year, the lack of broad description. This was too frequently illustrated in the answer to the first question, on the basin of the Yorkshire Ouse. Very many began their answers to that question with the words, "The Yorkshire Ouse is" without seeing that they had thereby changed the subject of the question. In a good paper (gaining 60 per cent. of the total marks) the statement occurred that "the whole of the basin of the Ouse is in the Vale of York." Very few of the sketch-maps showed any spurs of the Pennine Chain.

Shorthand.

Stage III.

In presenting my Report upon the Shorthand examinations for 1906, I desire to make a few preliminary observations with regard to the working of the new regulations, especially as they affect the Advanced Stage, in which section the standard of the examination has been raised. Under the old regulations the speeds were 110 and 140, a rate ample enough to cover any shorthand work outside verbatim reporting. The speed is now 120 and 150, and anyone obtaining the present Advanced Certificate must not only possess considerable dexterity in the use of the pen, but have a general education somewhat above the average. One result of raising the speed test for advanced students has been a decrease in the number of entrants, a result which was, of course, naturally to be expected, but the reason for the large percentage of failures in this division is not so readily perceptible. In this connection it is necessary to remember that shorthand is different from any of the other subjects of examination in that it is complete in itself. In languages, mathematics, history, &c., it is possible for a student to have a certain amount of knowledge which, while not complete, is yet, as far as it goes, definite and useful, and a working knowledge, but in shorthand partial knowledge is of no value whatever. The same remark applies, in principle, to speed. A shorthand student who can quite easily write and transcribe at the rate of 80 words a minute finds himself, at 100 words a minute, with a disorganised mass of notes, badly written, and full of mistakes and omissions, and consequently he is unable to furnish a transcript that is of any service. And as it is a common practice for writers of shorthand to overestimate their speed, in entering for an examination they frequently take a section for which they are not qualified. This, to a great extent, accounts for the large number of failures in the higher examination. The first-class passage in the present examination might appear somewhat difficult, but a student who is qualified to enter for the Advanced Certificate of the Society of Arts must be at least assumed to have a knowledge of the English language, and to be capable of dealing with any subject which that language is used to express. However, having regard to the fact that the present regulations exclude a certain class of candidates from competing for the Society's prizes and medals, and that the examination is largely utilised by students who have not had any great amount of practical experience, the Council might perhaps see their way to reverting to the previous speed of 140 for the First-class in Stage III.

With regard to the actual figures in the Advanced Section, the total entries were 783, as compared with 1,010 in 1905, or a decrease of 227. Of this number, 41 obtained First-class certificates, and 330 Second-class; 412 candidates failed, or more than half of the entrants, and the failures were, in the great majority of cases, due to an erroneous estimate of the student's capabilities. Had many of these students been content to enter for the Intermediate Stage they would undoubtedly have met with success. Amongst the 41 candidates obtaining First-class certificates I am pleased to be able to report that 23 candidates were really excellent. I am also pleased to report that the reading at the centres, on the whole, has improved, and in only five cases were there such variation in the time of reading as to necessitate my attention being called to it. It may be interesting to state that the shorthand machine has not been used in the present examinations.

Stage II.

In this stage the results are far more satisfactory than those in Stage III. There has been an increase of 143 in the number of entries, which amounted to 3,486, as against 3,343 in the previous year; 901

First-class certificates have been awarded, 1,241 Second-class, while the failures amount to 1,343. In 1905 the figures were 539, 1,400, and 1,404 respectively, so that it will be seen there has been a great improvement, especially in the First-class passage of this stage. Although there were very few signs of collusion or copying between the candidates in this division, I regret to say that, notwithstanding my repeated warnings, a large number of candidates have taken considerable liberty with their notes, altering and erasing, and in many instances substituting shorthand signs for contracted longhand used in taking down the dictation. This practice is open to abuse and should be stopped. For serious revision of his notes, one candidate, who might have been amongst the prize winners, had to be disqualified. I desire again to call attention to the necessity of candidates following the rules laid down. In several instances Rule 7 has been violated, candidates who have failed in the First-class passages omitting to send in their notes of the Second-class passage, throwing upon the examiner the onus of exercising his discretion on insufficient data in awarding a candidate who failed in the First-class passage a Second-class certificate. The shorthand notes are of material assistance in coming to a conclusion of the candidates' abilities, and I trust that in future the rule will be adhered to.

Stage I.

Very little need be said with regard to this stage. To all intents and purposes the figures are the same as last year, the total candidates being 2,218, as compared with 2,230 in 1905; 1,248 succeeded in obtaining certificates as against 1,240 last year, and 970 failed, or 20 less than in the previous examination. In this section the longhand writing in many instances was very bad, and the spelling inferior, the general standard of education in a great many cases holding out little hope that higher shorthand certificates will be obtained in the course of time without considerable attention being paid to other subjects of education. Indeed, this fact may be said to be one of the causes of so many failures in the higher stages. It would almost appear that a belief is current that shorthand is a sort of mechanical training which can be taken up by anyone with clever fingers, and consequently many present themselves for examination in shorthand who would be unable to pass an examination in the lower standards of an elementary school. It cannot be too much impressed upon all students that shorthand is but an instrument, and an instrument that can be only used effectively by educated people, and in the higher branches of shorthand work by persons possessed of education of a distinctly high order.

In conclusion, I would direct the attention of readers to the necessity of intimating to the candidates the moment when they are going to begin reading, as there were several instances in the present examination where candidates were under the impression that the reader was simply making a trial test of his voice.

Typewriting.

Stage III.

The results of the 1906 examination are embodied in the following comparative Table :—

Year.	Number of Papers worked.	First Class.		Second Class.		Not passed.	
		No.	Per cent.	No.	Per cent.	No.	Per cent.
1906..	363	70	19·30	171	47·10	122	33·60
1905..	375	59	15·74	188	50·13	128	34·13

Although a gratifying increase in the First-class passes has to be recorded, yet the quality of the practical tests was slightly inferior to that submitted last year, consequently, although the First-class pass standard was reached by eleven more candidates, yet the number of aggregate individual marks was lower than in the previous year. The increase is attributable :—

(*a*) To the clear, concise, and comprehensive answers given to the theory questions, and

(*b*) The excellence of the time test.

The display of the tests embracing the Directors' Report and the Endorsement left room for improvement.

The arrangement of the Balance Sheet was, with but few exceptions, weak, the matching of the Headlines and the Auditors' Certificate across the two sheets bore evidence of lack of training in this detail.

I recommend teachers to impress upon candidates the importance of perusing the manuscript tests before proceeding to type them—valuable marks are frequently lost through neglect to do this, *e.g.*, either omitting to insert the apostrophe to mark the possessive case, or marking the singular where the plural is required, as: Directors' Commission, Auditors' Fees, Trade Creditors' and Customers' Deposits, Company's affairs.

A standard of uniformity in typing money *columns* is desirable. Chaos at present exists, as is evidenced by the following examples: £20 - - 8 - - 9, £20-:-8-:-9, £20 : 8 : 9, £20 8 9, £20-8s.-9, £20 8s. 9d. I suggest the adoption of two blank spaces between the pounds and the units of the shillings, and the shillings and units of pence, as £20 8 9.

Stage II.

The following comparative Table illustrates the results of the 1906 examination contrasted with those of 1905 :—

Year.	Number of papers worked.	First Class.		Second Class.		Failed.	
		No.	Per cent.	No.	Per cent.	No.	Per cent.
1906..	780	159	20·38	372	47·70	249	31·92
1905..	933	115	12·31	511	54·71	307	32·98

A gratifying increase in the first-class passes and a slight decrease in the failures may be observed. The remarks relative to the time test, and the theoretical and practical tests in Stage III., apply also to this stage.

In last year's Report I pointed out the need of students being trained to secure effective distribution of matter over foolscap sheets by varying the depth of line-spacing, width of margin, &c. The three circulars comprising the practical test this year embraced in particular this essential, but improvement was scarcely perceptible. I would again urge the importance of a training conductive to the production of attractive and accurate work. Valuable marks were lost through :—(*a*) The typing of head-lines in small letters; (*b*) the erroneous employment of figures and symbols in the title of stock; (*c*) the insertion of a period after "st" and "th" in dates, and its omission after the abbreviation "cent." and similar abbreviations; (*d*) lack of observation, thought, or care, shown by the typing of "Manchester Suez Canal (First) Act, 1904," or Manchester South Company (French) Act, 1904," for "Manchester Ship Canal (Finance) Act, 1904," and this despite the fact that the designation occurs in full a couple of lines previously.

More careful scrutiny of candidates' preparatory studies appears desirable.

Stage I.

The results of the 1906 examination contrasted with those of 1905, are as follows:—

Year.	Number of Papers worked.	Passed.		Failed.	
		No.	Per cent.	No.	Per cent.
1906......	810	596	73·58	214	26·42
1905......	1,043	618	59·25	425	40·75

A marked increase in the passes and decrease in the failures is to be noted.

The quality of the work, generally, is good. The rendering of the manuscript letter was weak in numerous papers, many absurd blunders indicating a sad lack of thought or common-sense on the part of the candidates. I recommend that reading from manuscripts be given greater prominence in preparatory training; books containing suitable matter are now obtainable at small cost.

Economics.

Stages III. and II.

The number of candidates shows this year a considerable increase, and the general level of work is fairly satisfactory. The advice given last year, that candidates should be sure that they have grasped the meaning of a question, before they attempt to answer it, is still necessary, though there has been an improvement in this respect Candidates might with advantage give rather more attention to spelling, punctuation, and the construction of intelligible sentences; it is clear, I think, that the serious defects of many of the papers in this respect are not due solely, or even chiefly, to the hurry of the examination room. The increased number of papers is distinctly encouraging, and so I think is the quality of the work.

Précis-writing.

Stage III.

On the whole the result is satisfactory, and much of the work shows intelligence. Some of the work done by candidates who obtain First-class certificates is very good, and many of the candidates who did not succeed in obtaining any certificate in Stage III. would probably have done well in Stage II.

Stage II.

Some of those who obtain First-class certificates in this stage may in future do creditably in Stage III.; but it may be well to warn them, and others, to avoid drawing upon their imagination for facts, and to abstain from importing into their "Memorandum" any indication of personal prejudice for or against individuals or nations. They should bear in mind that the reader of the Memorandum does not want to be furnished with the views or opinions of the Précis-writer; but he does want to be made acquainted with the sources of information communicated, and to be put in possession of such dates as may be useful or material, as well as of other essential matter.

Candidates would often do well to arrange the Memorandum in paragraphs, and to remember that they are not asked to write an essay.

Commercial Law.

Stage III.

It is satisfactory to report that there was a substantial increase in the number of candidates in this subject, and also a slight amelioration in such an elementary matter as spelling. That quaint mistakes should occur where the number of examinees is large is natural, and this year the palm is to be borne by the ingenious writer who discussed contracts "void abadishio," but there is no wide gulf between him and the unpractical candidate with an inadequate conception of commercial possibilities who laid it down that when a ship founders and is lost the master is entitled to jettison the cargo.

The rearrangement of the paper so that the main subjects were specifically grouped and the candidates required to answer questions in each group seems to work well; the paper now demands an acquaintance with each branch of the law concerned, but still gives a choice of qaestions to be answered in each group. The regulation clearly set out at the head of the paper instructs candidates not to answer more than 12 questions, but was in many cases disregarded; it is, however, remarkable that the candidates who chose

to disregard this simple rule were in most cases those least competent to secure a certificate of any kind.

The paper contained 15 questions divided into five sets of three; the questions were believed to be stated simply and fairly, but many candidates have evidently been unable to rid themselves of the old and evil tradition that the aim of the examiner is to entrap the candidate instead of testing his knowledge in a fair way; as a result many highly ingenious hypotheses as to imaginary and unnecessary facts were developed, especially under QQ. 3, 5, 9, 13, and 14. It ought to be unnecessary to have to say that there is no intention of setting questions which are mere traps or catches.

The preliminary section of the paper, dealing with the elements of contract, was fairly well done; it was, however, distressing to find that not a few candidates distinguished a simple contract from a conveyance by alleging that the former created legal obligations between two parties, while the latter was a mode of removing goods from place to place. The fact that a majority of the answers to Q. 2 dealt solely with revocation by post of an offer is probably to be attributed to the undue prominence given to this particular aspect of the difficulty by almost all the text-books.

In the second group (Negotiable Instruments, &c.) no candidate even hinted in answer to Q. 4 that there are still such things as equitable assignments: here again the curious insistence on assignments under the Judicature Act, to the complete exclusion of assignment in equity, may be due to the fact that one of the text-books recommended, though otherwise in most respects excellent, excludes them just as much. Probably in commerce there are many more assignments in equity than under the statute.

The least satisfactory answers were those in Group 3, on the contract of carriage, yet the questions were elementary, and two of them involved little more than a knowledge of a few statutory provisions, and the question of seaworthiness was as simple a case as could be put as to an implied warranty. Those who did attempt Q. 8 as a rule confounded the warranty of seaworthiness under a charter party with the warranty implied in a voyage policy of insurance.

The questions on the Sale of Goods Act were better done, but Q. 12, which was perhaps rather difficult, was a stumbling-block to many, and Q. 10 was not as a rule fully dealt with.

The special section (on Principal and Agent) was, as last year, attempted by most of the candidates, but on the whole the result was not so satisfactory as might have been hoped. Especially in Q. 14 all sorts of hypotheses, more or less pertinent, were introduced into various answers, with the result that the replies wandered over much ground that could well have been left untraversed. In answering Q. 13 the fault, not absent indeed from several other questions, of not giving reasons, was glaringly conspicuous, and detracted considerably from the merit of various papers. In Q. 15 the custom of the trade was too frequently disregarded as a material element for consideration.

It would be just as well for candidates in an examination in Commercial Law to remember that the rules of the common law and the law merchant were, at any rate originally, founded in commonsense, and are not mere arbitrary dogmas; and if the candidates were to regard the questions asked from the point of view of a business man, and not—as some appear to do—as an occasion for an effort of memory of propositions in text-books, there would probably be a decided improvement in their work.

Accounting and Banking.

Stage III.

The number of candidates at the examination held this year was 322 as compared with 208 in 1905. The percentage of candidates who have obtained First-class certificates is rather higher than last year, but on the whole the average marks obtained is not quite so good, and the knowledge shown is a little less thorough.

Working to the Society's percentage standards of necessary pass marks, I have to report that of the above 322 candidates, 222 (68·94 per cent.) have passed, and 100 (31·06 per cent.) failed, being distributed thus:—

First-class	43	....	13·35 per cent.
Second-class ..	179	....	55·59 ,,
	222		68·94 ,,
Not passed....	100	....	31·06 ,,
Total	322	....	100·00 ,,

Comparing these with last year's results, we have:—

Year.	No. of Candidates.	Percentage of Passes.	Percentage of Failures.
1905....	208	70·67	29·33
1906....	322	68·94	31·06

Comparing the detailed results similarly, we have:—

Year.	First Class.		Second Class.		Not paseed.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
1905....	26	12·50	121	58·17	61	29·33
1906....	43	13·35	179	55·59	100	31·06

No candidate has obtained full marks. The Medals and Prizes have been well earned.

French.

Stage III.

The translation from French into English was generally good, but that from English into French was not equally creditable. The commercial phrases

were well handled by a large proportion of the candidates, and the improvement in this portion of the work was marked. A few essays were highly commendable in every respect, but in too many instances the style was anglicised and bald. On the whole the work in original composition left much to be desired. The treatment of the question on the gender and meaning of certain substantives was seldom adequate; the replies to the other grammatical questions were for the most part fairly good. Several candidates wasted time through not heeding the instructions printed at the head of the examination paper.

Stage II.

The translation from French into English was well done by nearly all the candidates. Though several excellent versions of the English passage set for translation into French were written, the majority could only be deemed moderate, and many were practically worthless. In many cases the faults seemed to suggest the impression that oral methods of teaching had too fully superseded those which are necessary for securing grammatical and orthographical accuracy. A combination of both methods might lead to better results. On the whole the answers to the grammatical questions were not sufficiently accurate. The handling of the questions on substantives and verbs was especially bad. The commercial portions of the paper were very well treated by a fairly large proportion of the candidates, and badly by comparatively few.

Stage I.

The renderings both of the French passage set for translation into English and of the French letter were good on the whole. Though several versions of the English passage set for translation into French were highly creditable, the bulk of the exercises did not rise above mediocrity and too many were exceedingly weak. Very few candidates were successful in their attempts at translating the English commercial letter into French. The questions on substantives were well answered by a large proportion of the candidates, but those on numerals and verbs were not so well handled. In most instances the renderings of the idiomatic phrases were commendable, but the treatment of the commercial ones was seldom good.

German.

Stage III.

Though the number of papers worked shows a falling off, the general standard was much more satisfactory than last year. More attention, however, must be paid to Grammar, both pure and applied. Candidates who write *er weiszt* or *ich lasse veran* cannot aspire to the First-class. In some papers words change their genders with Protean suddenness. Thus we find *Eine günstiger* Gelegenheit, and we read *von* einem *Krankheit*, die *er glaubt heilen zu können*. These, and such errors as *Unser Preis ist zwar höher als* den *von andern Fabriken*, are typical mistakes, and they indicate careless habits of thought. There seems to be the same carelessness in pronunciation, otherwise *Bitte*, zeihen *Sie so gut*. . . would scarcely have appeared in more papers than one as an example of the use of *zeihen*. Of the essays many were exceedingly good. In translating into English, candidates are warned against using words and constructions with which they are not familiar. What are *pathogogic residues*? What is to *obliviate*? "*Who*," says more than one candidate, "*can read this History* without *his blood* boils?" There was the usual crop of misspellings. In one paper *temprory*, *monoply*, *notority*, succeed one another at brief intervals. Many candidates wanted to send their princes to *goal*.

The habit of giving alternative renderings in a piece of continuous prose is to be deprecated. When examples are quoted to illustrate constructions, care must be taken that they are really to the point. *Er folgt uns* is an insufficient example of the government of *folgen*, but *er folgt mir* is excellent. In giving instances of separable and inseparable compound verbs many candidates gave no indication of which were which. In this way many marks were lost.

Stage II.

The quality of the papers differed widely at the various centres; some groups were as uniformly good as others were poor. Many candidates over-rated their capacity, for they failed to render adequately even the very simple passages in Part I. The translation into German was, as is usual, the least satisfactory part of most papers, and much ignorance was shown of the right order of words. The grammar, both pure and applied, was weak, and many candidates might have obtained a higher class but for absurd inconsistencies which betrayed not only ignorance of facts but a disregard of principles. Some ingenious compounds were formed, such as *Menschendieblergesellschaft* (band of robbers) and *Vergissmeinnichtreisegegenstände* (souvenirs of a journey). These monstrosities had at least the saving grace of imagination, which examples like *Euer Pferd lobt mich* have not. Strange things happened in Part I. Among other eccentricities the "Adjutant *seized a heart*," and Messrs. Randall and Goldsmith were requested to "*diminish the cause*" of the bearer's journey. Such translations should surely condemn themselves. There were again some candidates who resolved to be original at all costs, even at the cost of marks, and who wrote the whole paper, English and German alike, in German script. The misprint *es* for *er* in the first question misled only very few examinees, and in any case they have not been made to suffer by proxy for the negligence of others.

Stage I.

The Elementary German papers of 1906 exhibit precisely the same merits and defects as those of 1905. The ratio of passes and failures remains almost constant (59 : 41 per cent.), and the failures once again are often not so much failures in German as in common sense. Candidates have not sufficiently realised that

language is both a science and an art. There are certain rules common to all languages,—*e.g.*, the concords,—and these cannot be broken with impunity. Mistakes like *Hinter dem Haus war* einen *Garten* were as frequent as they are damaging. Many of the candidates did not see that the words and constructions required in Part III. (English-German) were almost all to be found in Part I. (German-English); others who grasped this fact introduced into their reproduction alterations which were not always improvements. In an inflected language slovenly thinking betrays itself at once. There were indications, too, of slovenly pronunciation. *Er* wurde *kommen*, *Wenn Sie mir sagen* konnten, &c., appear so often as conditionals that it is fair to assume that the modifications are ignored in pronunciation. The spelling was often eccentric: candidates are advised particularly to learn the use of *ss*, *sz*, and final *s*.'

Among the examples intended to show the cases governed by certain prepositions were many sentences that proved nothing at all: *Wir sind ohne Antwort*, and *Ich gehe nach Paris* prove nothing about the government of *ohne* or *nach*. The cases must not be ambiguous. Generally speaking, the answers that required thought were badly done, those that were cut-and-dried were more satisfactory. The English style was poor. "One does not leave their posts till you are releived" (*sic*) is unhappily not unique. Some candidates were aggressively commercial: "One dare not leave his post, until one remove him from same." Others were not commercial enough, and mistook the letter to Mr. Schmock for a begging-letter. Considering the easiness of the paper and the high marks obtained by the best candidates, the number of failures is greater than might reasonably have been expected.

Spanish.

Stage III.

I am pleased to be able to report most favourably on the result of the examination.

The majority of the papers worked bore unmistakeable evidence of a sound knowledge of the language. The work of those who have succeeded in obtaining First-class certificates was of an exceptionally high order. The commercial part was generally well done by all the candidates; also many of the essays were very good. The failures were chiefly due to the over-confidence of the candidates entering for the Advanced Stage without the requisite knowledge required for this high standard.

Stage II.

The work shown by the majority of the candidates was generally satisfactory. The translations were, as a rule, well rendered, as also was the commercial part. The weak points with a good many candidates were in the translation from English into Spanish of phrases demanding a practical application of certain grammatical rules, and the idioms and commercial phraseology were badly handled. I consider, however, the work, on the whole, commendable.

Stage I.

The result, on the whole, is satisfactory, the majority of the candidates made a good translation from Spanish into English, and possessed a fair knowledge of the rudiments of the language. The weakness most noticeable was in the conjugation of the verbs, and in the genders, together with a too limited vocabulary.

Portuguese.

Stage III.

Most of the candidates taking the Advanced Stage have shown a very fair knowledge of the language, but in my opinion the work this year is not of sufficient merit to allow of the award of the medal or prizes; such an award being intended for candidates showing a thoroughly good knowledge of the language.

Russian.

Stage III.

I am sorry to say that the average knowledge in Russian this year is less satisfactory than before. The candidates ought to give more attention to perfect their translation from English from Russian, to study more carefully the Russian grammar, and especially, to make themselves acquainted with commercial and technical expressions.

Stage II.

The average knowledge in this Stage also is lower than last year. The candidates do not practise sufficiently in their written exercises. Some of them cannot even properly write the Russian letters, and mix them up with English ones.

Japanese.

Stage II.

Five candidates presented themselves for the Intermediate Examination in Japanese, but, though the paper set was of an easy character, all the questions being such as any student should have been able to answer fairly well after six months' careful study of the prescribed text-book, and a very low standard was taken in allotting marks for the questions attempted, the highest that could, with the most extreme generosity, be given to any candidate was 36 out of a maximum of 100, and the average of those assigned to the five was less than 17.

The general character of the answers suggests that only one candidate—the one who obtained the highest marks—had used the prescribed text-book and the results in that case are not discouraging, merely showing that sufficient time or diligence had not been given to preparation, and that the student may fairly hope to make a much better appearance after further study. In the other cases different text-books seem to have been used, one candidate adopting an antiquated form of transliteration that is not found in any modern English work on Japanese. The paper set must therefore have presented greater difficulties to these candidates, and the answers in at least one case give promise that if the candidate uses the prescribed text-book, which in itself contains ample material for a year's diligent study, the examination may be again undertaken with every hope of success.

CANTOR LECTURES.

HERALDRY IN RELATION TO THE APPLIED ARTS.

By George W. Eve.

Lecture I.—Delivered May 14th, 1906.

In planning this course of lectures on the treatment of the heraldry that presents itself to be executed in various materials and methods, I was at first inclined to call them "Heraldry for Art Workers," but to do so would have narrowed their application in a serious way. For it is also to the patron that suggestions for the improvement of heraldic design should be addressed if the labours of the artist are to have their legitimate reward; and, on the other hand, the purchaser cannot be expected to encourage improvement in a form of decorative art whose qualities he does not understand, and whose value he is, therefore, unable to estimate.

I by no means ignore the encouragement, the preservative encouragement, of those whose countenance has done so much to revive interest in the artistic aspect of the subject; nor the artists who have responded to the stimulus of such appreciation. They have been few, perhaps, but the work has in no case been quite unworthy and in many instances is very good indeed. But it is not with them that we are specially concerned, for what is wanted is such improvement in the general level of work, in that of the die sinker, the plate engraver, the embroiderer, the glass painter, the decorative modeller, among others, as will raise the subject from the poverty of treatment that usually characterises it. Substituting vigour for feebleness and well considered design for the mere agglomeration of ill-related details.

So far, the effect of the work that Willement and Pugin began has had little influence on what may be called popular heraldry. Even in architecture, the Mother-art, which has produced some of the very finest examples in all times, there is much less than there should be of modern work that is worthy of its position. Many instances could be named, if it were not invidious, of fine schemes of sculptured decoration that are seriously blemished by the inefficient design of the heraldry which is such an important and inevitable feature. And this, not only from heraldic errors, though these are often far from being trivial, but from a general inferiority in the rest of the decoration, betraying but too surely the conscious fear with which it has been done.

Of another art craft, that of the die sinker and seal engraver, it is frequently said that to get good work done one must go abroad, and it is to be feared that this is true to a great extent, but it should not be true of this or of any of the crafts. No doubt commercial competition, the craze for cheapness at all cost, and for art at stores' prices, have something to do with this but not everything, and much may be done to encourage apprentices and students to do better work than the mere repetition of stock patterns, and that without a too violent departure from an accepted style. Indeed styles, as such, have much less to do with heraldic excellence than is often supposed. A broader view of the decorative possibilities is necessary, a knowledge of why, as well as of how good work was done in the past, and also (or rather, consequently) a clear idea of what qualities to try for in the present.

The indication of heraldic principles presents some difficulty, owing to the varied needs of those who are concerned with the subject. In the more distinctively heraldic crafts, a knowledge of the heraldic system may be assumed to exist, and so the foundation is provided for an improved treatment. In other arts and crafts, those in which heraldry occurs only as an occasional motive, the greater probability of technical heraldic error has to be reckoned with, for it is in them that mis-statements of heraldic fact most frequently occur, even to the extent of drawing the royal lions of England with their heads in profile, thereby making another coat-of-arms, or of omitting the distinctive tressure from the arms of Scotland, both lapses from heraldic grammar that are by no means infrequent.

It will therefore be necessary to refer, in a very simple way, to general rules which, to many here, are already known. In the suggestions that it will be my privilege to make, I propose therefore to consider the needs of those who, having no special heraldic knowledge, are likely to be provided with a correct sketch of an armorial motive with a view to its execution in any suitable material.

We must not forget that the statements that heraldry makes may be of the greatest personal, corporate, or national importance, and so accuracy and artistry must go together.

Heraldry grew out of the widespread use of personal badges, a practice which had existed from the earliest historic times, and became crystallised into a system of carefully regulated

devices somewhere about the twelfth century. The closing up of the head armour, until it wholly covered the face, also afforded an excellent reason for using distinctive marks by which the wearer might be known, and the added value that was thus acquired by personal badges was given further expression by the pageantry of the tournament, whose splendour always come to mind as the inevitable background of early heraldry.

Though in its beginning heraldry essentially marked the fighting men, its decorative quality and compact significance extended its use, in the course of time, to other parts of the community, civil and religious, until it represented every important interest—cities and boroughs, trade guilds and simple merchants, as well as kings and nobles, and other components of the feudal system, with which heraldry was at first identified. This extension of its scope was particularly marked at the period of the Renaissance, to which much of the modern use of heraldry may be referred.

Symbolism, which pervaded the whole life of the Middle Ages, and imparted beautiful meanings to everything, naturally ascribed spiritual qualities to heraldic bearings; and such symbolism was, no doubt, one of the powerful influences in the choice of armorials in early times. But although the symbolic meaning of the heraldic figures continued to be tabulated in treatises until a late period, the influence constantly tended to become weaker, until it practically ceased, or became merged in an allusive, rather than a purely symbolic quality. Some chance object would be adopted as a memento of a notable deed, and even when the symbolic reason had influenced the first bearer, his subsequent deeds and the glory that he acquired built up round his arms a family sanctity, that in time quite overshadowed the symbolic meaning.

Purely symbolic charges, however, still occur, such as the bee as an emblem of industry, the ship for commerce, the palm of victory, and the dove for peace, among the many others that will readily come to mind.

A noteworthy feature of the early work, the work on whose excellence in strength, simplicity, and expressiveness we are all, I think, agreed, was the common-sense nature of the methods that were followed. That is to say, the artist knew what he was doing and why he did it. For good heraldry is never at variance with sound common-sense, and is always able to give a reasonable answer to a fair question. Therefore, in the study of old work, in order the better to learn how to do our own, we need never hesitate to inquire why things are so. And the knowledge that is thereby gained cannot fail to benefit the work.

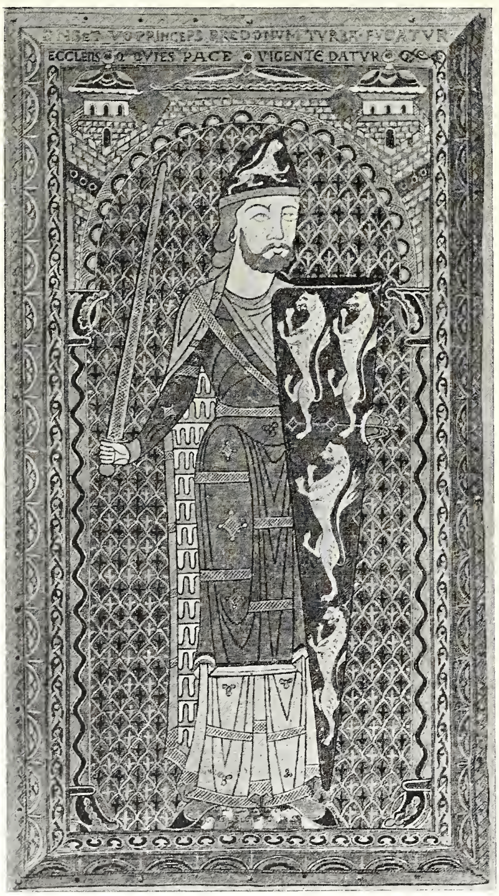
In the course of time heraldic devices were displayed on many parts of the armour, but it was the shield that was and still is of primary importance. Before proceeding to consider its form, and the evolution which it has undergone, it will be well to mention that the shape of a shield has, in general, no heraldic significance whatever (the sole exception, the lozenge shape on which some ladies' armorials are borne, being put aside for the present). That is to say, a given coat-of-arms may be placed on any other shaped shield, that is artistically fitting, without in any way varying the statement of heraldic fact. The consequent power of choice, in the shield shape, is a very valuable one, in connection with the adaptation of the shields to their bearings, to the various spaces they occupy, and to the character of their surroundings.

Let us now consider this principal heraldic object, the shield; as an actual defence, such as it would appear in representations of historical events, and afterwards as developed into decorative forms. From classic times downwards it was an object of peculiar regard, as a part of a man's armour which was especially identified with its owner, and which it was dishonour to lose. It had an interest that was almost a sanctity, and it was, therefore, natural that an emblem of such supreme importance as the personal device should find space for its expression on an already symbolic shield. Also its detachability, and the ease with which it could be displayed hung by its belt from some convenient support made it an appropriate representative of its owner, and as such it was considered and treated in a variety of ways, honourable and otherwise.

The shape with which regular heraldry was first associated is that known as the Norman shield, which was tall and narrow, actually about four feet high and about half that in width, and being strongly curved from side to side, partially encircled the body. It was pointed at the foot, and could be thrust into the ground and held in position by the fighting man when he was dismounted. Such shields were made of strong thicknesses of leather covering a wooden substructure and strengthened with bands and bosses of metal, and it was from these reinforcing pieces that certain plain heraldic forms,

called ordinaries, are sometimes thought to be derived. Among the earliest examples of the regularly charged Norman shield is one that was executed, in *champlévé* enamel, on the magnificent tomb of Geoffrey Plantagenet Count of Anjou, the progenitor of our Plantagenent kings (Fig. 1). In this typical case

Fig. 1.



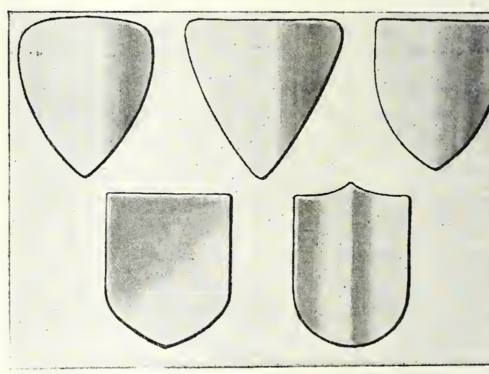
the shield is very large, extending from the shoulder to the ankle, the top edge is straight, and forms right angles with the upper parts of the sides, the corners being slightly rounded. In other cases, of somewhat similar shields, the top is semi-circular. This latter form survived for a considerable time and is still used in Italy for decorative shields.

The difficulty of managing the long shield when it was used by a mounted man led to its gradual shortening until by the end of the twelfth century ti was of about the length of the torso and later still became much smaller and nearly equi-lateral. No doubt the increased defensive power of the whole armour contributed to the decrease in the size of the shield.

The quality of the curves which form the sides varied considerably, in some cases being rather full, swelling slightly from the rounded upper corners and becoming flatter as they met to form the point, Fig. 2 (1). Others more nearly approached the flat lines of an equilateral triangle, the upper corners being distinctly rounded, though they became more angular in later examples (2). For a considerable period the lines of the sides began their curvature quite at the top, until at the beginning of the fourteenth century they began in straight lines, which formed right angles at the top, and, at about a quarter of the height, developed into

Fig. 2.

(1) (2) (3)



(4) (5)

the point curves (3). This form is well known as the "heater" shape, from its resemblance to the heater of a smoothing iron, and suits bearings that are simple, especially such as are not crowded in the base or lower part of the shield. It of course goes well with gothic surroundings, but may seem somewhat affected among modern work. I mean an affectation of antiquity. It seems to demand strong, simple treatment of the mantling and other accessories.

The next shape is, perhaps, the most useful of all the plain shields, and so it has never ceased to be employed since its inception in the fourteenth century. It is nearly square, about five parts in height to four in width, the base being round, or nearly so—that is to say, the base lines meet in a blunt point, or one semicircular line suffices for the whole base. This shape is equally suitable to most bearings, either single coats or the more complicated combinations of quartered arms which sometimes present such difficulty. It is thus

peculiarly suitable to series of arms which naturally vary in character.

There were also large square shields, called *pavoises*, used for fighting on foot, and having a projecting rib down the middle. Another form had, instead of the broad rib, a sharp ridge or arris (5). This is said to be the last to have been used in actual battle, and probably suggested the similar line which was so marked a feature of some of the later decorative shields, such as that on the next slide, an engraving by Martin Schöngauer, which will serve as an initial example of the artistic modification of an actual form (Fig. 3).

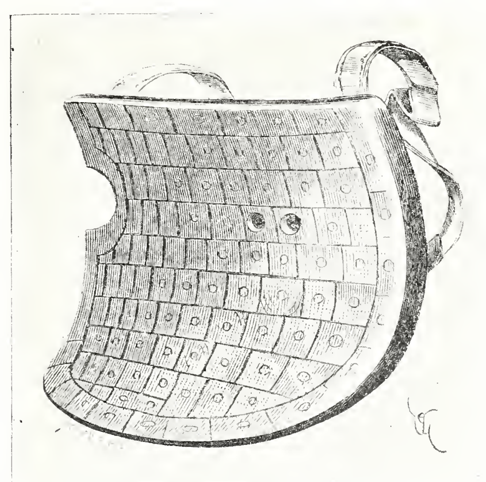
It should, therefore, be noted that, although shields are represented flatly, in most cases, on the monuments and seals, they were in actual

Fig. 3.

fact curved in one or more directions; and this curvature may, of course, be extremely valuable, especially in modelled work, from the play of light and shade and the variety of line that the surfaces afford. As was natural, the simple curvatures of the early shields were dictated by the practical necessities of defence, and to the forms which resulted the later decorative shields, gave fanciful development. The general principle of all defence is that it is easier to deflect a blow than to directly resist it, and in the application of this principle, the curve of the shield was at first from side to side, as we have seen, then in order to prevent a blow from glancing downwards, the base of the shield was made to project, so that the attacking point was carried on to the sloping sides, from which it slid off. Finally the top was also brought slightly forward so that the whole shield had a double curvature, convex from side to side and concave perpendicularly.

It remains to describe a form of actual shield which greatly influenced those decorative escutcheons which were designed in such great variety in the fifteenth and sixteenth centuries, by which time the battle use of the shield had become obsolete and when the present freedom of shield design may be said to have begun. This was the shield *à bouche*, the special tournament defence, with a gap in its right hand margin, through which the lance could be placed so that the shield fitted closely against the guard-plate of the weapon, thereby making a closer defence. (Fig. 4.) This gap, or embouchure, was sometimes at the top of the

Fig. 4.



shield but was more usually at the side. In a great many instances one or other of the various shapes of tournament shield was followed fairly closely in the seals and in other forms of decorative work, as in Fig. 5 (1), and the cusped form (3) also came into extensive use, which continued into the first half of the sixteenth century. Further variety was obtained by the addition of foliated decoration, which followed the lines of the shield, as in that of Henry V. on his stall plate in St. George's Chapel, Windsor (2).

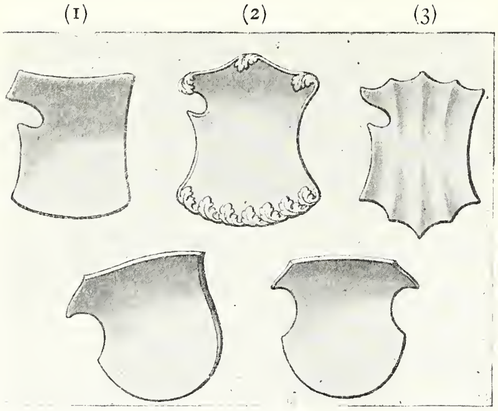
The distinctive *bouche*, however, perhaps conveys too direct an allusion to the tournament to harmonise with merely decorative modern use, but by omitting the *bouche* and duplicating the other side of the shield the objection is avoided and some good forms may be arrived at.

Another method by which the tournament

shield was freely developed into purely decorative form is shown when the *bouche* side of the shield was made to give but a mere indication of the opening (4), while in others it merged into a line swinging without a break from the projecting point. When one of these forms was duplicated the result was something like (5), and in this way an infinity of shield shapes was devised and were either left in their simple line, or further ornamented with foliation, which thus completed the transition from the actual motive to the decorative equivalent. Such a foliated shield occurs in the large woodcut of the arms of Herr Kress of Kressenstein, who was one of the Nuremberg friends of Durer.

In the works of Martin Schöngauer, Israel Van Meckenen, Albert Durer, the Behams,

FIG. 5.



Burghmair, Virgil Solis, Aldegrever, and Jost Amman among others, an enormous number of ornamental shield shapes occur, which are evolutions from the tournament form in some of the ways that I have indicated, with the added influence of the classically derived scrolls and volutes of contemporary decoration.

It is easy to deduce from the foregoing that a space of any shape may serve as a field for a coat-of-arms. But, as I have already indicated, there is the unfortunate exception in the lozenge-shaped shield on which it has become customary to depict the arms of widows and of unmarried ladies. In most instances it is exceedingly difficult, if not impossible, to adjust its bearings to it in a satisfactory way, especially where cheverons between charges are concerned, though this difficulty may be somewhat lessened by substituting curves for the straight outline of the lozenge ; and here it may be usefully noted that its sides may be of any form, and that its angles may be rounded to a very considerable extent so long as the general idea of a lozenge-shaped space is present.

In designing or choosing a shield shape, it must be remembered that the first duty of the shield is to display its bearings in the most effective way, with the greatest distinctness and decorative effect. It should also be in itself of pleasant and suitable shape in its relation to the lines and character of the mantling or other decoration that may enclose it, and to the helmets, coronets, or other objects, that may form part of a general composition.

The natural convexity of the early shields is, as you know, generally ignored in their artistic rendering, in illumination especially they are represented as flat, but in sculpture, in seal engraving (which is a form of sculpture), and in engraving, a concave form is frequently employed. Perhaps suggested by the hollow shields or, as is more likely, by the nature of the work itself.

This is extremely valuable, for on a convex surface the lights on the bearings may become confused in the broad light on the shield, and their shadow sides be partially or wholly lost in its shadow, whereas the concave surface distributes the light and shade over the whole field in a kind of decorative counterchange. The shadow under the lighted rim gives value to the lighted side of the charges, whose definition is completed on the other side by their shadows in contrast with the field, which in that part comes forward and takes light.

Before proceeding to discuss the treatment of the bearings of the shield it will be necessary to say a few words on the subject of heraldic language. Heraldry, like other systems of knowledge, requires the use of technical terms, and these sometimes act, at first sight, as a deterrent to its study. Such terms, however, have become needlessly complicated, for most of them that one find in treatises on the subject are of such infrequent use that they may be put aside in a general way, to be looked up in a glossary when occasion requires. But there are certain principal terms which it is necessary to keep in mind. For practical purposes the names of objects, the means of expressing their relative positions, and of defining the heraldic poses of the animals will suffice, and this is comparatively simple. The great point to keep in mind is that there should be no doubt, or inaccuracy, about the essential heraldic facts on the one hand, and no un-

necessary insistence on unimportant detail on the other. Heraldry is naturally governed by its significance, and consequently artistic variation is permissible only so far as heraldic or symbolic statement is not interfered with; for in working from a sketch which is often a merely diagrammatic indication of the armorials, this question of how far it may be improved, in an artistic sense, without impairing its validity as heraldry, will continually arise. And it will be found that its interpretation will be greatly helped by the technical heraldic description called Blazon, for in it will be found all that is really essential. It is not desirable perhaps further to describe the method here; it will be found described, at more or less length, in all treatises on heraldry, and with a little trouble will be easily understood.

The simplest coat-of-arms that is possible is, of course, one which consists solely of a plain surface of one tincture, such as the plain golden shield of Pope Alexander III. in the twelfth century, or the simple ermine shield of Brittany, which occurs so frequently in French heraldic decoration as the arms of Anne of Brittany, the Queen of Louis XII.

The Field, or surface of the shield, may be divided in various directions, and so become parti-coloured; and though the exigencies of material, as in sculpture, may cause the spaces to be indicated by sunk planes, they are in theory but divisions of the surface, and are so represented in painting; also in sculpture they may be divided by raised (or by incised) lines; but the countersinking is better. The simple charges, the perpendicular Pale, the horizontal Fess, the oblique Bend, the Borders round the shield, the Cross, and so forth—forms which normally extend to the edges of the shield, and are called ordinaries, are considered to be superposed on the surface, and in sculpture are frequently accented by being bevelled at their edges, which thus acquire more emphatic light and shade.

The proportion of the ordinaries to other charges and to the field is obviously a most important point, and the first thing to do in this connection is to quite put out of mind any idea whatever of a fixed scale. The only true principle is that which makes for unmistakeable clearness of definition by means of artistic balance and good distribution, suitably expressed in the material concerned. It was on this principle that the mediæval designers worked, with that common sense regard for practical necessities which they always combined with their extraordinary instinct for design. The tomb of Louis Robsart Lord Bourchier in Westminster may be taken as an example, and in this particular attention should be given to the engrailed cross. It is very much narrower than seventeenth century writers prescribed, there is no question of exactly one-third or one-fifth of the surface, but there is also no question of its sufficing clearness of definition, while ample space is left for the other charges, the water bougets, aud for their treatment with appropriate largeness; the whole effect being that of a well decorated space of which all the details are distinctly legible.

Since we are dealing with the subject mainly with a view to the interpretation of a provided sketch it will be well to keep in mind the principal points concerning the arrangement of charges on a shield. Their number must be noted, for, except when a field is said to be powdered or sown, *semé*, with a charge many times repeated (in which case the number is indefinite), the number of the charges is of primary heraldic importance. The order in which charges are arranged, next claims attention. This, like their number and heraldic disposition must never be tampered with, their size, however, and their consequent distance apart may be anything within the compass of the shield that the artist wishes.

Of all the various charges on heraldic shields the animals naturally attract most attention, and the lion in particular is of especial interest, not only for the variety of its pose and treatment, in which connection it serves as a telling example of the characteristics and changes of heraldic style, but as the principal part in the royal arms of both England and Scotland, it is a figure with which every art worker has, sooner or later, to deal, and it therefore presents a very suitable means of showing what is essential in heraldic pose, as well as what is to be aimed at in artistic treatment.

It is, of course, easy to understand that when the number of persons bearing symbolic emblems were few, he who bore a lion, for instance (having no other lions in his neighbourhood), would have the animal represented in any pose that suited the space that it had to occupy, so that in an upright space, like that of a pointed shield, the beast would be ramping upright, but in a horizontal space would assume a horizontal attitude, and this is exactly what happened in early times on warriors' shields and headpieces. The thing was a lion, and that was enough. When, however, lion-bearing personages increased in

number, some means of distinguishing one from another became obviously necessary, and among those means set variations of pose were found most effectual, and so they became endowed with a regular heraldic significance, and constituted valid distinction between otherwise similar bearings.

This will suffice to show the importance of so rendering a given coat-of-arms as to avoid any alteration that may, as it sometimes does, result in turning one coat into another. I will therefore endeavour, as shortly as I can, to explain what is heraldically essential in animal pose. This may be broadly classed under three heads :—(1) The general direction of the animal, (2) the arrangement of its limbs and (3) the pose of the head. Putting aside for the moment certain comparatively unusual

Fig. 6.

attitudes, which will be referred to later, we find that the general pose divides itself into two classes, one of them more or less perpendicular in direction, rampant, and the other horizontal, passant.

As I have indicated, both these poses occur in the royal arms, in those of Scotland, a lion rampant within a tressure, and of England, three lions passant-guardant in pale. The arrangement of the limbs is somewhat similar in both positions, all four legs being clearly separate, one forepaw being strongly raised in an attitude of vigorous rage. This clear division of the limbs is heraldically important, for if, for instance, the hind legs of a rampant lion are placed close together, the beast is said to be saliant (leaping) instead of rampant, and is a different bearing altogether. The illustration shows a lion passant-guardant—that which is called a lion of England. (Fig. 6). This is from another of Martin Schöngauer's engravings, and is additionally interesting as a survival of the Gothic type in renaissance work. The passant lion becomes statant when the four legs are placed as though the animal were standing on all of them ; and this is, of course, another definite and distinctive pose. One of the before-mentioned attitudes, saliant, is very rare, being probably of comparatively recent differentiation from rampant ; and the other pose, statant, usually occurs in crests. It is necessary, however, to keep them in mind in order to avoid confusion.

We have now to consider the pose of the head, and it must be understood, in the first place, that in heraldry an animal's head is always meant to be in profile—the simplest way in which an object can be drawn—unless some other position is specified. Other positions of the head are full-faced, gardant, as in the last slide, and another looking backwards, a comparatively rare pose, which is known as regardant. A little latitude is permitted in modification of these three distinctive positions of the head, but only so far as escapes all possibility of misunderstanding. Thus the profile head may be turned until the further brow is visible. On the other hand, a beast that is in the gardant position need not be quite full-faced.

The positions that have been described, viz., rampant and passant, are those commonly met with, but besides the somewhat similar positions of saliant and statant, which have also been mentioned, there are others, such as sejant, sitting on the haunches with the fore-legs upright, like Stevens's lion, or with one leg employed in supporting an object, such as the shield that is held by the well-known lion by Donatello, in Florence ; and couchant, lying with the forelegs extended, the attitude of Landseer's lions in Trafalgar-square.

Much of this may seem unpleasantly restrictive of artistic freedom, but as it is essential to the accurate rendering of the subject, it is an inevitable condition of heraldic design. It remains to the artist to make the heraldic statement in as beautiful and expressive a way as he can. Let us therefore consider some of the qualities that go to make a satisfactory work.

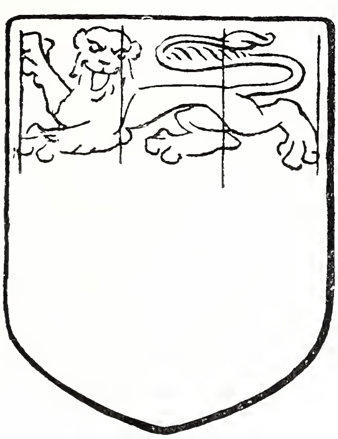
The placing of the animals as charges will naturally present most difficulties, for whatever their pose they must occupy their spaces in such a way as to express their character with the utmost distinctness, while at

the same time covering the field in a decorative manner. That is to say, good distribution is of the greatest importance in all good heraldry. Very excellent examples of it are to be found in most of the work of the mediæval period, especially in the fourteenth century. In fact,

Fig. 7.

good distribution and vigorous expression are its most characteristic points. The ceremonial shield that was borne in the funeral procession of Edward the Black Prince, and was afterwards hung over his tomb in Canterbury Cathedral, and the no less remarkable

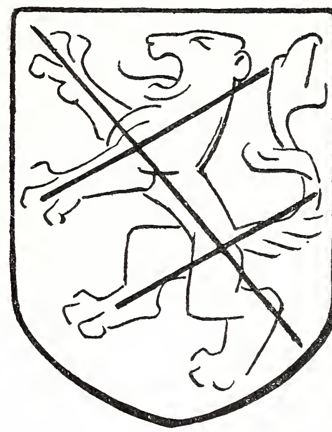
Fig. 8.



sculptured shield of his uncle, Prince John of Eltham in Westminster Abbey are instances in point. Notice there the adaptation of the figures to the varying demands of space. The preservation of the heraldic pose and the great spirit of the whole work. Other excellent examples may be found on the contemporary seals.

This shield shows among other excellent qualities the characteristic attenuation of the animals, which is a most striking feature of mediæval work, and is a good instance of the adaptation of figures to the condition of their heraldic use, an ever present proof of the reasonableness of the mediæval artist.

Fig. 9.



In the earlier shields the figures were done with a considerable degree of reference to natural form, very simply expressed, like those of the Saracenic silks. Soon, however, the necessity for clear definition of the bearings on a shield

Fig. 10.

or banner suggested the additional emphasis of the figures in their fields and resulted in the peculiarly heraldic character, which makes so much for practical decorative effect. In this, as in so many other cases, a common-sense regard for the practical quality, legibility, resulted in the effective attainment of the decorative one.

As guides to setting out lions on shields, a sort of skeleton method, is often found useful in which simple lines, indicating the general direction and placing, are drawn, and the forms are built up on these in due relation to the field and to each other. Fig. 7 shows this method applied to passant-guardant lions in the Arms of England.

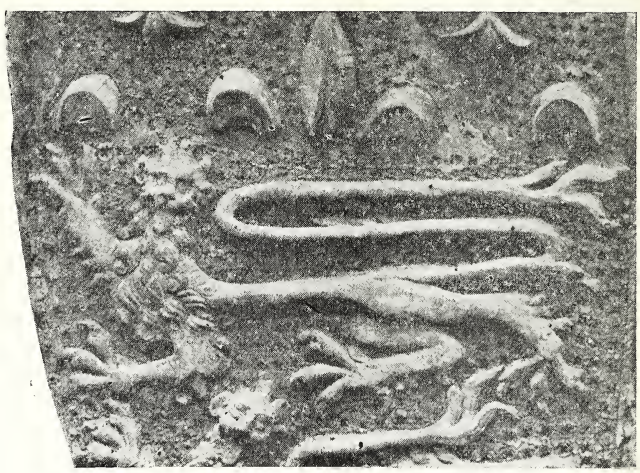
An approximate indication of the proportion of a lion-passant may be found by dividing the space into three parts, when the division will fall something like (Fig. 8) at or rather within the shoulder, and cross the hind leg near the setting on of the tail. In a similar manner the blocking out of a rampant lion may be begun as in (Fig. 9), and proportion may be indicated by dividing the space into five parts, when the second from the top will indicate the shoulder and the third division will mark the place of the loins (Fig. 10).

The drawing of heraldic figures should be firm and decided, every line being made to do the most of which it is capable in expressiveness of character and in decorative force. The pose of the figures, in complying with the heraldic rules, and with the requirements of ornamental distribution, should still be in accordance with anatomical possibilities; and by this I mean that physical distortion for the purpose of getting a figure into a space is offensive and unnecessary.

In thus arranging the limbs to occupy satisfactorily the given space the play of the shoulder is very important, not only in the strong forward reach of the uppermost fore-leg, in the positions of passant and rampant, but also in the drawing back of the other fore-leg on the body, where the narrowness of the containing space requires it.

It will, therefore, be desirable to study animal anatomy, at least so far as will fix in the mind the position of the principal joints and their range of movement, as well as the more important muscles and other surface characteristics. The muscular masses of the shoulder play an important part in the suggestion of power, and this may be helped by the treatment of the mane. That very distinctive leonine feature usually covers the whole forepart of the body to the line of the shoulder where it joins the trunk; but if it is disposed in the natural way, covering the neck and chest but leaving the shoulder bare, as in some wild lions and in those of the Assyrian and other eastern sculptures, the modelling of the muscular shoulder is emphasised and the suggestion of strength is more marked. It is not, of course, intended to import such forms unchanged into a shield, but only that the lesson of simple and direct expression of leonine power and character should be learnt from them.

FIG. 11.

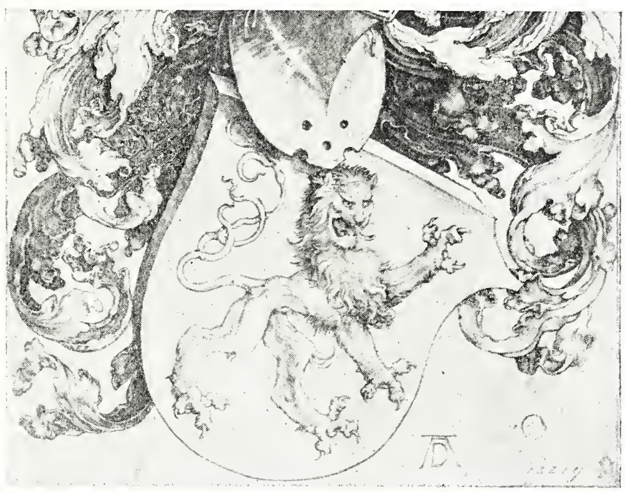


Characterisation should be strong and definite, and, above all, the expression of vigour should always be intended. Vigour in the animals is, perhaps, the most striking quality of good heraldry, however different it may be in style and period. An unerring sign of decline in heraldic art is always the loss of vitality in the animals. If we look again at the lions of the Black Prince and of John of Eltham, it is the astonishing vigour of the beasts, no less than their admirable distribution, which appeals to us. (Fig. 11.)

The mediæval designer was, of course, influenced by the symbolic qualities of courage, magnanimity, and power that were ascribed to the lion, and he tried, no doubt, to express them, but vigour seems to have been his principal aim ; and if in the pursuit of it he exaggerated the toes into forms that were claw-like, we forgive the grotesqueness for the sake of the supreme vitality that resulted.

Vigour, again, was characteristic of the better kind of Renaissance work, as may be seen in the well-known coat-of-arms with a cock, by Albert Durer, as vigorous, though different in style, as the old Gothic. (Fig. 12.) In this, as you see, the general Gothic pose is followed, and the distribution is good, though the lion is smaller in proportion to the space it occupies. It is evident that there was here the intention to express natural form, as indeed the older men had intended within the measure of their knowledge.

Fig. 12.



The treatment of the wide-stretched paw is no unimportant part of the expression of that vigorous rage, which is the character and sanction of the principal heraldic poses, and without which they become feebly ridiculous. Also these claw-like toes had full warrant in nature, and, if we look at the paw of the domestic cat when it stretches itself, we shall get a very good idea of what the paw of a lion would look like in vigorous action. The toes divide to a remarkable extent, showing much of the character of the mediæval form.

To the absence of vigour the lions that we know so well in ordinary commercial heraldry owe their absurd appearance. Their original designers seem to have looked at a tame beast in a menagerie, and (determined to do something more natural than those wild Gothic fellows) looked at him as he stood blinking in his quiescent state, drew him propped up into heraldic attitudes and let him go at that. The next slide shows that this treatment began by the Italians as long ago as the fifteenth century and we copied them. The vital distinction between good and bad treatment of heraldic animals consists in the recognition of something beyond mere form, namely, the expression of emotion, of the heraldic emotion of active rage. And this may be seen in the Gothic heraldry of the Middle Ages, in its time of strength and in its decline, no less than in the comparison of, say, the lions of Schongauer and Durer with those of Della Robbia. Now, as a horrid example, we may refer to a lion that adorned a book of crests in the early nineteenth century (and a by no means bad example of its time). (Fig. 13.) This is far from being expressive of vigorous rage, but rather calls to mind the awful threat of the Rev. Robert Spalding in the "Private Secretary" that he "would really have to give you a good hard knock."

Before leaving the lion it will be well to point out explicitly what has already been implied, viz., the desirability of filling the field space to a satisfactory extent. Returning to the Black Prince's shield we remember that the English lions stretch from side to side and thus decorate the whole surface.

Neglect of this was a conspicuous feature of the work of last century when it became customary to depict these same lions of England in a column down the middle of their field with a

great blank space on either side. There has been some gradual improvement (in the heraldry of the coinage for example) but in this, and some other respects, the courage to go to the full extent of the decorative possibilities seems still to be lacking.

To sum up the qualities that are to be aimed

FIG. 13.

at in depicting a shield of arms they are:—A shape of shield that is suitable to all the circumstances of its use and surroundings. Clear definition of its bearings by means of direct and simple drawing, and just proportion between the charges and their fields. Good distribution over the shield space, and in the animals strong characterisation combined with the utmost vigour that can be expressed.

AGRICULTURAL CO-OPERATION.

It is perhaps a little surprising that the co-operative movement, which in some directions has made considerable progress in the United Kingdom, has made small headway amongst the agricultural classes of the kingdom. On the Continent, and particularly in Austria and Germany, it is in this direction that its progress has been most marked. These countries have no distributive societies (stores) which can compare in membership and turnover with the great societies of the United Kingdom, but in agricultural co-operation, alike for selling, buying, and banking, they are very important. In Austria, says Mr. Wilson Fox, in his introduction to the third Abstract of Foreign Labour Statistics (Cd. 3120), just published, the principle of association has been applied to agriculture in every direction. There are productive societies of many kinds, purchase societies, distributive societies, co-operative creameries and dairies; there are vine-growers' societies and co-operative grain-storage societies; and, above all, there are the co-operative banks which, to the number of between 6,000 and 7,000, form a network of credit agencies covering the whole country. These banks are of two kinds, as in Germany, the Raiffeisein and Schulze-Delitzsch. The latter are fewer in number than the former, but their membership and resources are both larger. All the societies together have a million and a-half shareholders, and share and loan capital of £66,250,000, besides reserves of £3,000,000. In Germany, the credit associations form the vast majority of the co-operative societies, and here again the Schultze - Delitzsch lead with their half a million members. Of agricultural co-operators of all kinds there were, in 1904, 401,656. Agricultural co-operation predominates also in France (which had 3,116 "syndicates," with 659,953 members at the end of 1904), as well as in Russia, Belgium, Luxemburg, and in Denmark, where 1,057 co-operative creameries produced butter to the value of £8,400,000 in 1903. The distributive societies (stores) and agricultural credit associations (banks) of Russia are not numerous proportionately to the great extent of the urban and rural population respectively.

It may be interesting to go a little into detail. Take agricultural co-operation in Denmark. The number of creameries in existence there in 1903 was 1,057; the membership 150,000; the milk delivered during the year 935,000,000 gallons, the butter produced therefrom 1,580,000 cwts., the value of the butter produced £8,400,000. The number of co-operative bacon-curing factories was 27, and the value of the pigs killed, £2,500,000. The number of associations for the purchase of agricultural implements in Germany increased from 89, in 1901, to 269 in 1904, and the membership from 1,903 to 6,078. The advances made by the co-operative credit associations (rural banks) rose from £657,089 in 1893, to £4,616,590 in 1903, and the profit (balance in capital account) made in the latter year was £67,770. In Holland, the number of agricultural associations for the purchase of manures, seeds, &c., rose from 3 in 1890 to 227 in 1904; rural banks from 2 to 275, and insurance associations from 2 to 26. In Belgium the number of co-operative societies rose from 311 in 1894 to 2,172 in 1904, and the number of agricultural supply associations from 337 to 884, whilst the number of members increased from 26,726 to 51,451, and the value of seeds, manures, feeding stuffs, machines, fuel, &c., purchased by societies, from £204,990 to £895,198. In France, the agricultural associations (Syndicats Agricoles), formed under the law of 1884, rose from 648, with a membership of 234,234 in 1890, to 3,116, with a membership of 659,953 in 1905. We see the same growth, although, of course, on a much smaller scale, in Switzerland. In Italy, again, the number of co-operative credit associations (people's banks) have grown from 310 in 1884, with deposits, &c., of £11,635,520, to 736 in 1902, with deposits, &c.,

amounting to £21,563,240. But the greatest increase of all has been in Austria, where the credit associations have increased from 1,464 in 1889, to 6,553 in 1903, and the total associations from 1,916 to 9,729. The associations for production in Austria have risen from 173 in 1894, to 792 in 1902, and the number of members from 8,833 to 47,481. In Hungary, the dairy associations numbered, in 1897, 34, their membership was 2 767, and the value of the milk and butter produced was £22,470. In 1903 the societies had increased to 517, their membership to 50,450, and the value of their produce to £439,746. In all the countries named, and in some others, co-operation has been of great assistance to agriculturists. More might, perhaps, be done in that direction in the United Kingdom.

THE GREAT MEXICAN SODA LAKES.

Over on the great desert south of Yuma, on the Sonora side and near the Gulf of California, lies a property belonging to the Mexican Government, which is destined to become some day a source of great revenue to it; for on it are the famous carbonate lakes of the Bay of Adair. Under the blazing sun of the desert, surrounded by barren and bleak sand dunes, lie vast lakes of crystals of carbonate of soda, to all appearances great masses of snow and ice, but in reality a substance from which will be made millions of tons of soap and millions of panes of glass. At only one other place in the world is natural soda found under conditions which admit of industrial development, and at that place it must be shipped several hundred miles by rail, and many tons of water must be evaporated by coal to obtain a ton of the product.

In Sonora, the lakes are within 3,000 yards of the sea, and the fierce sun and heat of the desert attend to the evaporation. The world's consumption is very large, amounting to several hundred thousand tons annually, and at present nearly all of it is manufactured from common salt, and with the use of expensive machinery. At Adair Bay, when the temperature is right, the water of the lake crystallises into pure carbonate of soda, nature doing what man requires expensive machinery and vast amounts of coal to do.

As before stated, these lakes are the property of the Mexican Government, and it declines to sell them to anyone, President Diaz believing that they may become sources of enormous income to the country, just as the nitrate of soda beds are to Chili.

What it may mean to the soap and glass industry of Mexico, may be judged when it is stated that the present manufactured soda, one of the principal items of cost, sells for 75 dollars per ton in ports of the country, while the same article from Adair Bay may be delivered for less than one-third of that price. The source of the soda in the lakes is evidently found in the numerous springs of comparatively fresh water around the edges of the lakes. This water contains a small percentage of carbonate of soda, but centuries of continual evaporation of the water, leaving a soda residue, has formed a practically unlimited amount of the pure soda. An estimate of an engineer gives enough on top of the ground to produce one hundred tons daily for seventy-five years. From this may be seen that the Mexican Government has acted wisely in reserving to itself the proprietorship of these lakes. They signify untold wealth to the nation.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in August:—

New Charts.—1914—England, south coast; Looe harbour. 3563—Norway, western approaches to Vigten islands, Giaeslingerne light to Kalvö. 3562—Baltic, Little Belt:—Apenrade and Flensburger fiords, including Alsen fiord and sund. 3344—Fort Liberté, Manzanillo, and Monte Cristi bays. 3590—South America, Magellan strait. Plans in the neighbourhood of Beagle channel:—Port Langlois and Port Edwards. Sholl bay; Port Estrecho; Port Fanny; Port Almeida; Port Sophia; Port Huemel; Port Fortuna; Port Quo Vadis; Port Barrow; Port Engano; Port Util. 1156—Mexico, south-west coast:—Gulf of California, Topolombampo harbour. 3595—Red sea; Gulf of Akaba:—Jezirat Faraun. 3599—Plans and anchorages in the Persian gulf; Henjam island anchorage. 3586—Malacca strait, Sumatra, north-east coast; Aru bay. 3577—Borneo island:—Sesajap and Bulangan rivers. 3548—Japan:—Yokohama to Uraga.

New Plans and Plans added.—1304—Plans on the coast of Chile. New plan:—Ticton bay. Plans added:—Port Auchemo: Port Velcho. 1508—Anchorages in the New Hebrides islands. Plan added:—Betarara anchorage.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—1607—England, east coast:—River Thames; North Foreland to the Nore. 847—Cyprus:—Famagusta and Salamis; Famagusta harbour. 2478—Africa, west coast:—Manna river to Junk river. 7—Gulf of Aden:—Aden and adjacent bays. 2195—Celebes sea:—Plans in east part of Celebes. 976—Philippine islands:—Manila bay. 1798—China, north coast:—Kwang tung peninsula including Ta lien hwan and the approaches to Port Arthur. 1270—Korea:—Approaches to Chemulpo anchorage.

These charts are issued by Mr. J. D. Potter, 145, Minories.

HOME INDUSTRIES.

Labour and Capital.—It almost seems as if leading home industries will have to reckon with a period of serious industrial disturbance consequent upon acute disagreements between employers and employed. The strike in the Clyde shipbuilding yards, to which reference was made in these Notes last week, is now a reality. Because the employers would not consent to an advance of 5 per cent. on piecework wages, and of 1s. 6d. per cent. on time wages, some 7,000 riveters, platers, fitters, caulkers, &c., have come out, and a very much larger number of men must be affected if the strike goes on. The strike of the artisans must displace a number of helpers and other labourers, and affect joiners and carpenters. The engine shops and boiler shops, too, wlll find themselves at a standstill, and there must be arrest of production in iron and steel works, and collieries. It may well be that 50,000 men will be idle before long, and the number must be much larger if the strike extends to the Tyne, whence a similar demand has been made to that which has brought about the trouble on the Clyde. The suspension of the earnings of such an immense body of highly-paid workmen must react upon large numbers of shopkeepers and tradesmen. Unfortunately there is no immediate prospect of settlement. The crisis has come at an opportune time for the shipbuilders, who are rapidly completing their old orders, without getting many new ones. On the other hand the workmen, or the younger section, seem to be spoiling for a fight, and until they have been taught by sharp experience what a fight of the kind means, they may be indisposed to listen to the counsels of prudence. Another kind of industrial conflict is going on in South Wales. There, at any rate at present, there is no conflict between employer and employed. The quarrel is amongst the men only. The South Wales Miners' Federation wants to get rid of the non union element in the coalfield, and 30,000 members of the Federation handed in, on the 1st instant, a month's notice to quit work. But this is only a precautionary measure. The owners are neutral, but it is understood that they are inclined to favour the Federation in the matter, preferring to see all their workmen amongst its members. Be that as it may, it is hoped that the crisis will be got over without actual cessation of work. Then again, the textile workers in Yorkshire are moving for an advance in wages, urging that they are receiving on an average 7s. less per week than those in Lancashire. A conference is shortly to be held to draw up a general wages scale for weavers using the hundred four-picks looms, and there is some anxiety as to the result. Should the manufacturers not agree to the scale, there may be trouble with thousands of workers in Huddersfield and the Colne Valley districts, who are now enjoying prosperous trade. Altogether, there is much disturbance in the industrial world.

Whisky Production.—A table in the Inland Revenue Report just published shows that the average consumption per head of home-made spirits retained in the United Kingdom for consumption has decreased from ·95 of a proof gallon in 1899-1900, to ·75 in 1905-6, the average in 1904-5 being ·77 of a proof gallon. Or to put it in another way, the consumption of home-made spirits in the United Kingdom in the past year was 670,986 gallons less than in the preceding twelve months. The quantity of whisky distilled in Scotland during the year ended March 31, 1906, was 23,812,839 proof gallons, a decrease of 1,372,396 gallons, as compared with the previous year. The decrease is less than in the previous year—1,372,356 as against 1,925,942 gallons—but as compared with the "record" year 1898-99, the production is less by nearly 12,000,000 gallons. With the exception of 1903-4 there has been decrease in each year since 1898-99. Turning to the figures of the stocks in bonded warehouses, it will be found that the quantity in bonded warehouses in Scotland at March 31 last was 120,242,108 gallons, or 1,535,931 gallons less than at the same date of the previous year, it being the first time for a decade that a decrease has been shown. But whilst the Scottish production of spirits has been reduced by the quantity mentioned, the output of Ireland has increased by nearly a million gallons, and there has also been increase in England. The increase in Ireland may be attributed to the fact that in the previous year the output fell to a lower level than for many years previously, and the decrease in Scotland was largely due to the desire of the distillers, both pot still and patent still, to restrict output in view of the fact that the stocks exceeded the actual requirements of the trade, consumption dwindling year by year. But last year the consumption showed little if any decline. Even now the stocks in the bonded warehouses are equal to more than 4½ years consumption, while ten years ago they were equal to only 3½ years' consumption. As to what is whisky, representations have been made to the Local Government Board and the Board of Trade that an early settlement of the question is most necessary in the interests of the trade, but no reply has yet been received to these representations. On the other hand, a new summons under the Merchandise Marks Act has been taken out for selling as "Old Highland Scotch Whisky" a kind containing a large proportion of patent-still spirit. This summons raises the much wider question "What is Highland whisky?" The question of the status of grain and blended whisky is in itself sufficiently contentious without extending the controversy to other knotty points.

The Leather Trade.—The expected international advance in the price of leather has not, except in a few particular grades, taken place. There has been a rise, but it has been comparatively small. Present stocks are less than they used to be, and light substance sole leather is very scarce, but there are comparatively large supplies of heavy sole leather, light weights making more than heavy ones. Enormous numbers of hides are now split every week for upholstering

motor-cars, and motor clothing also accounts for a big demand for sheep leathers. Other purposes call for big supplies of the same class of stuff, and the present range of prices is, consequently, higher than what it used to be. Prime tanned calf skins can command up to 2s. 9d. per lb., and sheep leathers have maintained their ranges of prices, owing to the reduced supply of pelts, for splitting purposes, which are to-day making 40s. per dozen, as against 22s. to 25s. per dozen a few years ago. The raw hide and skin supply has shown good increases. The following figures from the Board of Trade returns show that tanners and dressers have received for their own use much larger supplies than last year :—

	Hides.		Goat and Sheep Skins.
	£		£
Net imports :—			
1905......	1,008,953	....	741,523
1906......	1,310,887	....	1,189,740
Export of Hides :—			
1905......	402,752	....	—
1906......	498,580	....	—

Deducting the increase in exports of hides, £95,828, from the net excess of imports of hides, £301,934, there remains a balance of £206 10s. worth of hides to the good for tanners' use, and £348,215 of goat and sheep skins.

English and American Locomotives.—A report from the American Consul-General at Cairo would seem to show that it is not only the English manufacturer who neglects his opportunities in foreign markets. According to the Consul-General, "the American manufacturer will not build machines adapted to the soil and climatic conditions of Egypt and the Soudan; he will not believe that his deep-ploughing machine ruin the land by turning up the salty soil below, nor that machinery which will do the work claimed for them in America can quickly break down and fail to work at all in Egypt." The Consul-General goes on to say that "the American locomotives supplied to the Egyptian government consume a great deal more fuel than the locomotives from either England or Germany." That is hardly borne out by Mr. F. Trevithick's report (enclosure 6 in Lord Cromer's last report on Egypt, Cd. 2817). In 1901, the Mechanical Department of the Egyptian State Railways made certain trials between locomotives of similar weight and power, but respectively of British and American design and make. These trials were exhaustive and complete as regards coal consumption, but included neither the results with regard to the amount of oil used nor, as the engines were new, the cost of repairs. From that date up to the end of last year these twenty engines averaged 137,000 miles each, and Mr. Trevithick gives figures taken from the registers with regard to the consumption of oil, and also the respective cost of maintenance of each manufacture with the following result :—

	British		American.
	£		£
Oil............	134	....	128
Repairs........	753	....	830
Total....	887	....	958

These fuel figures relate to the average cost per engine for 137,000 miles, and the Americans have a trifling advantage. The substantial superiority of the British is in repairs. And this is also shown in comparison with German and Austrian. Under all three heads of coal, oil, repairs, the British figures work out the best, the average cost per engine for 120,000 miles being for the British £3,048, the German £3,083, and the Austrian £3,175. But the initial cost of the British engine is higher, £3,245 as against the German £2,917, and the Austrian £2,935.

The Prudential Assurance Company.—It may be a stretch of language to describe this great institution as a "home industry," but seeing that in its Industrial Department alone it employs 16,234 agents, and that its total number of industrial policies in 1905 was 16,065,268, the organisation of the company is almost, if not altogether, a national concern. The figures become more stupendous year by year. The report for 1905 shows that the company's assets on the last day of the year amounted to £59,464,376. The number of new policies issued in its ordinary Life Department in 1905 was 75,293, assuring the sum of £7,211,427, and producing a new annual premium income of £395,029, or more than twice the new life business reported by any other company. The ordinary life funds increased from £29,362,013 to £31,658,165, and were some 80 per cent. more than the funds of any other life office are likely to have amounted to on December 31st last. In addition to a total ordinary life premium income of £4,213,319 the company received in 1905 £100,039 as consideration for new annuities granted. £929,744 was paid to the representatives of policy holders and £882,874 to holders of endowment assurances. The net interest earnings in the ordinary department amounted to £1,043,677. The total industrial premium income was £6,139,050, while the claims amounted to £2,261,749, and the expenses, inclusive of commission, to £2,450,668. The Industrial Life Fund rose to £23,974,117. About two-fifths of the whole population of the United Kingdom, of all ages, are insured in the company for small sums in return for weekly contributions amounting to less than 2d. a week.

Cotton.—It is hardly surprising that there has been a sharp rise in the American quotations for cotton. There has been a very severe hurricane which passed over much of the American cotton area, and inflicted considerable damage. This disaster came at a time when the condition of the market was favourable to fears of short supply. The visible supply of cotton for the world at the end of September of all sorts was 1,421,000 bales, as against 1,532,000 in 1904, and

2,377,000 in 1905. The movement into sight for September was 998,000 bales, against 1,362,000 in the same month of 1904, and 1,315,000 in 1905. The shipments to Great Britain for the same month were 195,000 bales, as against 445,000 bales in 1904, and 199,000 bales in 1905. Supplies were short, and the trade in yarn and cloth very active and profitable, so that it is not strange that the hurricane, with the inevitable exaggerations in the reports of it, induced much higher quotations. An unfavourable report from the Washington Bureau, prepared just before the hurricane, and estimating the crop condition at 71·6 per cent. as compared with 71·2 for the same month last year, pointed to a crop no better than that of last year. The result was a rise in the quotation to 6·14d. per lb. which, however, has not been maintained. Present estimates put the American crop that year at about 12,000,000 bales, the consumption of the world being 12,000,000. From other countries, the reports are fairly favourable. Manufacturers are very active, the export trade to India showing considerable recovery, and the exports to the Levant, Egypt, and South America, being very satisfactory. The home demand, too, is good, and given adequate supplies, of which there is fair prospect, next year promises to show a continuance of the good times for the cotton industry which has been such a marked feature of the industrial world during the last two years.

GENERAL NOTES.

Illegal Arrest of Sailors.—In his report on the trade and commerce of Savannah (Cd. 2,682), Mr. Acting-Consul Harkness warns shipmasters that in many of the Southern States there is no law in force that permits the arrest of seamen for refusing duty. At the port of Charlestown, last year, one shipmaster had nine suits for damages brought against his vessel, by as many members of his crew, for an aggravated case where they refused duty under circumstances that almost amounted to mutiny. The court sustained the contention of the men, and it eventually cost the ship upwards of one thousand dollars to compromise and settle the case. Even in arrests for desertion under the existing treaty experience shows that it would be well for masters to be circumspect in their method of procedure, in order that they keep within treaty provisions, and that they may be sustained by the United States Courts in case of habeas corpus proceedings, which are always possible under these circumstances. It is sometimes unfortunately the case that British shipmasters are inclined to act independently and unwisely in these matters, and to deal directly with police and officials who are without proper power of authority to arrest seamen for alleged desertion, this being a matter for State magistrates and United States Commissioners to perform.

British Trade with Dantzig.—In his report on the trade and commerce of the Consular district of Dantzig, Colonel Brookfield points to the continued decline in the number of British ships visiting the port, the number last year being twenty-one less than in 1904, and fifty-nine less than in 1900. For the first time in the history of the United Kingdom's commercial intercourse with the port not a single sailing vessel appeared there during 1905. The diminution in the number of vessels calling at the port has, to some extent, been made up by the larger tonnage of vessels going there, but in tonnage too there is a shrinkage, as from 138,331 tons in 1900, to 93,602 tons in 1905. Salt has for many years past been one of the staple imports from the United Kingdom, and last year over 80,000 cwts. were imported. Unfortunately, owing to the operation of the new tariff, this commodity will for the future be practically excluded from the Dantzig market. The year 1905 was a fairly good one for the producers and sellers of amber, and the supply of raw amber was, as usual, unable to keep pace with the demand. For the manufactured articles of the best kind, on the other hand, the demand fell away, and has been doing so for some time past. Of amberoid, about the same quantity was turned out as in the preceding year, and there was again a good demand for amber acid and amber oil. With regard to melted amber for use in the varnish trade, while the demand from abroad increased, the total demand considerably diminished, owing to the fact that those engaged in the German varnish trade have found that the use of copal in place of amber answers their purposes be tter

Elephant Stealing in Siam.—In his report on the trade of Chiengmai (Cd. 2682) Mr. Consul Stringer refers to the theft of elephants, mention of which has been made in preceding reports. He says it is increasing. One of the British firms in Chiengmai reports that they had twelve of their own elephants stolen last year, and about the same number belonging to their contractors. Another firm reports that nine elephants belonging to them and their contractors were stolen during the year, and that only three of these were recovered. As most of the elephants that are stolen are timber elephants, employed in the teak forests, and the average value per head of such elephants is £200 or more, the persistent stealing of these animals, which now goes on in the district results in heavy loss to the teak merchants and their contractors (most of whom are British subjects), since in addition to the value of an elephant, the owner's forest work suffers considerably, even if only one is stolen; and if it is recovered he has to pay large sums in rewards to the captors, unless he has recovered it himself. Complaints are made that the officials render little assistance in tracking and recapturing stolen elephants belonging to private persons, and that when one is recovered, the recapture is generally due to the energy and perseverance of the owner or a search party sent out by him.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CANTOR LECTURES ON FIRE.

Professor Vivian B. Lewes's Cantor Lectures on "Fire, Fire Risks and Fire Prevention" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full text of the Cantor Lectures which have been published separately, and are still on sale, can be obtained on application to the Secretary.

EXAMINATIONS.

The Programme for 1907 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. (post free 4d.). Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The Examinations are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The Commercial subjects include:—Book-keeping, Accounting and Banking, Shorthand, Type-writing, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages.

The Examinations will commence on Monday, April 15, 1907.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted in each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates will be given; in Harmony Higher, Intermediate, and Elementary Certificates.

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments of Music are the same as for Stages II. and III.

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

HERALDRY IN RELATION TO THE APPLIED ARTS.

By George W. Eve.

Lecture II.—Delivered May 21st, 1906.

The imaginary animals that occur with such conspicuous effect in heraldic design would well repay the expenditure of more time than we can devote to them now. I must, however, be content to mention a few of their characteristics. The Unicorn perhaps interests us most as an important part of the Royal Insignia. You may remember that two unicorns were the supporters of the Royal Scottish Arms (Fig. 14), and when King James succeeded to the English Crown he used one of them as his heraldic supporter, with the lion of England on the other side, as they appear to this day. In so doing, the Tudor dragon, the

dragon of Cadwallader, was displaced as a supporter though it still remains a Royal badge. The unicorn is of composite character having the head and body like those of a horse with the legs and cloven hoofs of a stag. A twisted horn issues from the midst of its forehead and its tail is usually that of a lion, in some cases is that of a horse, but it also has a tuft under

Fig. 14.

the chin and others on the legs as a lion has. An instance of the latter form occurs in the supporters to the arms of the Goldsmiths' Company. Another form of unicorn, shaped like a goat, was also described in the "Bestiaries," those early and very meagre natural histories which supplied information (of a sort) to the mediæval artist. This suggested the goat-like type of unicorn, with a short tufty tail, that occurs in foreign heraldry, the German and Swiss work for example, and no doubt it was from one of these sources that Pugin took the type when he introduced it into the Royal Armorials in the windows of the Houses of Parliament.

It is somewhat interesting to remember that the actual existence of such wonderful beasts was thoroughly believed in, certainly as late as the sixteenth century, and the most amazing stories were told of them. Of the unicorn, it was said that he was so strong, and of such extraordinary swiftness, that the hunters were unable to capture him except by means of a trap, of which, sad to say, beauty was the bait. For it was quite well known, in the Middle Ages, that the only way was to place a beautiful maiden in a wood, when the unicorn, being pressed by the hunters, fled to her, laid his head on her lap, went fast asleep, and so was taken. Whether this touching story was meant to suggest that, however strong one may be, it is well not be too trustful, I do not know, but it has been the subject of many works of art in various materials.

Next to the unicorn the Griffin is most popular, as is shown by the application of its name to a creature which is not a griffin at all, viz., the Dragon supporter of the arms of the City of London, at the place in the Strand where Temple Bar formerly marked the dividing line between London and Westminster. Griffins are half eagle and half lion, a lion's body, with eagle's wings and head, and with eagle's legs for its forelegs. It must be particularly noticed that the head has large ears, and these form the distinction—a necessary one when a head only occurs—between that of a griffin and that of an eagle. Griffins in pairs form admirable decoration, as is seen in the front of a fifteenth century coffer in modelled and painted gesso that is in the Victoria and Albert Museum. The griffin that heads the procession in Hans Burghmair's wonderful series of wood blocks in

Fig. 15.

which is shown the Triumph of Maximilian is seen in Fig. 15. For dignity and power, as well as masterly draughtsmanship, this magnificent figure is the best of its kind. It should be noted that the lop ears of this fine example are a very free departure from the erect ones of the more usual heraldic type of griffin's head. Otherwise it would be difficult, if not impossible, to find a better model.

Dragons are imaginary rather than composite creatures, and vary much in character, in many instances having a hard scaliness that is suggestive of the Chinese variety. In other examples a greater sinuosity and a more leathery texture is apparent, recalling the idea of "the loathly worm" of some ancient dragon legend. It was made part of the Royal armorials by Henry VII., whose favourite badge it was, and became one of the supporters of his arms after flying, as a badge on a banner, over the fateful field of Bosworth. Fig. 16 shows the dragon as it appears on one of the seals of Henry VIII., and an example of eighteenth century treatment occurs in the finely engraved arms of the City of London (Fig. 17).

Fig. 16.

As a specially Welsh badge it has been recently assigned to the Prince of Wales in addition to the familiar ostrich feathers. As a symbol of evil, terrible but overcome, it is associated with St. George and with St. Michael. It also appears very frequently in Italian decoration with more personal allusion, as the device of the Guelphic faction in their contest with the Ghibellines.

The character of the dragon's head has also varied very much, from being comparatively short and spiky, resembling somewhat the demons' heads of the Assyrian sculptures, to having a much longer and more crocodile-like form, and to this there is now a tendency to revert. It is important to note that in English heraldry a dragon has four legs, and that a somewhat similar creature which has but two is called a Wyvern, but that it is the latter form which is known to foreign heraldry as a dragon.

The Crest is next in importance to the armorial shield and therefore demands a similar attention. Originally it was the badge displayed on the top of the helmet, in which conspicuous position it was even more distinguishable than the arms on the shield. It was at first a purely personal bearing that was confined to such as were actually knights. The knightly rank was very important, and we find Henry III. swearing to observe a covenant—"As I am a man, as I am a Christian, as I am a knight," and this importance accounts for the special estimation in which the crest was

Fig. 17.

held, apart from its prominence in the mimic battle and from its position as the apex of the heraldic group. This also accounts for its tardy acquisition of that hereditary quality which made the shield a family matter no less than a personal one.

The first kind of crest-like ornament to appear on the helms, which became so intimately associated with this kind of device, was an artificial derivation from what may be called a natural crest, a plume or panache of feathers. This was probably made of leather or of thin metal, in the fan shape that appears on some of the seals. Some interesting crests of shaped leather occur on the Celtic headpieces in some of the painted MSS. as early as the ninth century, but it would be too far-fetched, perhaps, to suggest any special con

nection between them and the fan crests of four centuries later, for helmets had rarely at any period been without some kind of crest decoration. The crested helm of Pallas Athene comes to mind as a classic instance, with its triple crest ridges adorned with owls and winged horses.

The fan-shaped crests developed into a flat form with a cusped edge and this was treated as a space on which to repeat the arms (or perhaps a single charge) rather than as a definite bearing in itself.

It has been mentioned that a crest is a badge or device placed on a helm, and it is worth noting that when it is removed from its helm it may be used as a badge again, an adaptation that may be very useful in allusive heraldry in cases where the whole arms may not be suitable to the general design.

The crest was but little used in actual battle, but in the tournament it was of the greatest moment, hardly inferior in importance to the shield itself, whose place as a distinguishing mark was indeed sometimes taken by it. In tourneying, as distinct from jousting (when pointless swords and other blunt weapons were used), the shield was dispensed with altogether and the crest became the distinguishing device. But even in such cases the knights were loth to part with the armorial shield, and so they often had it depicted on the front of the helmet or on the mantling which flowed from it.

In the ceremonial of the tournament, in the chivalric display which preceded the combats of the lists, the crest, with its helm representing its knightly owner, took a very prominent place. All the crested helms were solemnly borne by pages to the helm-showing, where, ranged in order by the heralds and the judges of the tournament, they were carefully inspected by the ladies, who were conducted in stately procession round the hall. And woe to the unlucky knight whose helm a lady touched, thereby accusing him of some fault against chivalry; for he was at once arrested, promptly tried, and, if found guilty, punished according to the laws of the tournament and according to the magnitude of his offence.

Few examples of actual crests survive from those picturesque times, among the most notable being the lion crest that was carried in the funeral procession of Edward the Black Prince, and afterwards hung over his tomb in Canterbury Cathedral, where it still is. (Fig. 18). Another is that of the Spanish hero, James (The Conqueror), King of Arragon, in the Royal Armoury, Madrid; and a third is the dragon's head crest that was formerly in the celebrated Bardini collection, now dispersed. This dragon crest is a very bold and striking example of Florentine work of the late fifteenth century, and is probably the best specimen of a tournament crest that remains. High and sinuous crests seemed to have found great favour with the Italian nobility as is evident in the armorial tablets and panels of the architectural decoration. The Bardini example is about 17 inches high, modelled in leather and painted, and the torse is also represented modelled in the same material.

Prince Edward's crest, which accompanies the shield that we have already examined,

Fig. 18.

must have been a very fine piece of work when its eyes and tongue were in their places, and the tail, perhaps, had a more spirited pose, but even in its present state it is a very interesting example. Shaped in plastic leather finished with gesso (in which suggestions of hair have been modelled), it was afterwards gilt and painted. The eyes were probably of glass, or may even have been jewels. Leather, softened by soaking in hot water, was the ordinary material for modelling crests, a core of wood being often employed to give stability to the whole. In other cases crests were modelled over a framework of wicker, and paper and canvas were used, as well as leather, with which to build up the figure, the final surface being nearly always of painted and gilt gesso.

The comparative lightness of the materials of which crests were composed enabled them to be made of imposing size, a fact to be taken full advantage of in representing them, and this has been the custom in all good heraldic

work. Their heraldic importance, and their artistic value at the top of a composition, alike tending to exaggerate what was already large, until, in much of the work of the fifteenth and sixteenth centuries, they became enormous.

A crest was firmly laced, or else bolted, to the helm by means of holes in the crown plate, so that, while quite stable in its position, it could be easily removed when necessary. In some cases it was fixed on a kind of skull cap, which fitted over the top of the helm, and was thus easily removed from one to another of the different head-pieces that were devised for the various uses of the tournament. We will, however, deal with the form and structure of the helmet a little later.

As I said before, it is very improbable that crests were ever much used in actual battle, and certainly such use as they had soon ceased, for it was found that they afforded a dangerous handle by which a man could be pulled down by an adversary, and there are many stories of men being taken prisoners, or even being killed, in this manner. It is true that it was attempted to revive their battle use at the end of the fifteenth century, but only with similarly disastrous results. This was when the Italian nobility tried to carry tournament fashions into war, to their own great discomfiture. You will remember Uccello's battle-piece in the National Gallery, in which the combatants wear very elaborate crests, though they are without the flying draperies that contemporary writers ridiculed so much.

The crest usually sloped somewhat backward on its helm, so that it assumed the perpendicular position when the head of its wearer bent naturally forward in the position of the charge, and this attitude is generally reproduced in the tilting forward of the helm in heraldic groups consisting of arms, helmet and crest.

In depicting crests the sense of stability should always be kept well in mind, for the suggestion of being, as it were, a part of its support, and not of being merely balanced on it, is essential to good heraldic design. Doubtless it was due to such practical necessities that so many of the early crests were demi-animals, animal's heads, and other objects which could be secured in their places with least difficulty. At the same time, whatever meaning or symbolism was intended by the complete figure, was equally conveyed by its more convenient representative.

Here again practical necessities, and the way in which they were met, resulted in decorative excellence, the lines of the crest being thus brought into pleasant relation with those of the helm and mantling in a very admirable manner. Heads are particularly effective in this way. They were often treated as a sort of cap to the helm, and merged, without a break, into the mantling. Whole animals were usually in the statant position of the crest of Edward the Black Prince and of the Royal Crest of the present day, the militant rage of the lion in the shield being somewhat curbed in the crest by the necessity for a firm fixture.

These were some of the considerations that influenced early heraldic design, and are points that may be usefully kept in mind in interpreting it.

It would seem superfluous to say that animals as crests should face in the same direction as the helm, that is, in the direction of advance, if it were not for the fact that surprising instances exist of lions and other beasts placed across a helm, and even being made to face towards the back of it. The position of a knight's crest looking over his shoulder, or down his back, would have somewhat astonished the heralds at a tournament, and the spectators would have "made remarks" without doubt.

In the general decline of decorative art in the seventeenth century heraldry came off very badly, and the crest especially suffered ill-treatment. This was intensified by the impractical nature of many of the large number of new crests that were devised during the period that began soon after the cessation of the tournaments and continued until modern times; such as objects of all sorts between branches or between pairs of wings that are posed fore and aft on the helmet, one pointing over the wearer's nose and the other down his back; objects placed with much confusion in front of each other; rows of small objects in front of the principal one; and even birds flying and quite detached from support.

In one sense the evolution of a modern crest is exactly the reverse of the ancient method. Then the device was first produced in the round, as an actual crest, and consequently its transition thence, to any form of applied design, gave rise to no trouble of a structural nature. In more modern times, crests appear to be devised solely with regard to heraldic difference, and as though they were to be viewed from but one aspect, any possible treatment in the round being generally left completely out of sight. As though newells and finials (carved in wood or stone, or cast in

metal) or silver work (such as the handle of a cup-cover) had never been heard of. One feels a sense of injury at the very existence of things that almost defy good treatment, and even though it is the duty of an artist to tackle difficulties and beat them, he cannot help resenting their unnecessary aggravation.

The principal difficulties in an ordinary way occur in regard to objects that are between branches or pairs of wings, especially when the last are charged with other objects.

In the last lecture I alluded to the difficulties that arise in the treatment of a certain kind of complicated crest as a matter of special interest to modellers, though it concerns all forms of heraldic design, and an illustration will make this clear. Suppose a lion's head between two palm branches—a not uncommon kind of arrangement—it is usually represented with the branches posed fore and aft on the helm. But the result would be, when seen from the front, that one of the branches would obscure the principal motive. If, however, the details be drawn in due relation to the helmet, and the direction in which it faces, both the profile and the full-faced view would be equally satisfactory, and the crest would still be in accordance with the technical description. Further, suppose that there are three things in a row in front of the crest — three fleurs-de-lis, for example—and these also are placed in relation to the front of the helm, the best will have been done so far as pose is concerned. A very good way in such cases, in all heraldic design (besides modelling), is to knock up a rough sketch in clay or other plastic material, pose it in the way that is best for definition and decorative effect, and draw it from that point of view. In this way many of the difficulties that occur in depicting such subjects in flat design may also be got over.

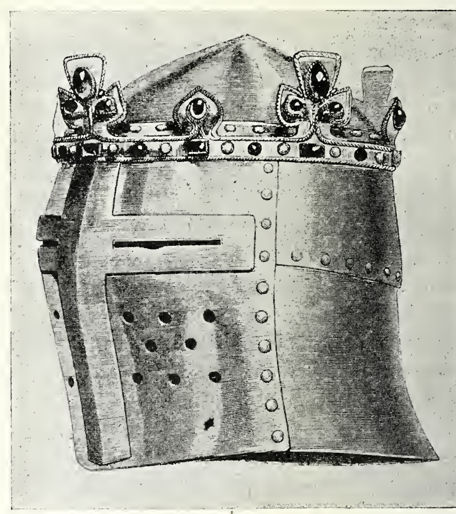
It is well to leave to the last the addition of the torse, that parti-coloured wreath of twisted silk that usually encircles the base of the crest, where it joins the helm. Otherwise, it has a tendency to attract to itself too much attention, as though it were really the point of issue for the crest, that it sometimes seems to be; whereas the real support is, of course, the helm that the torse also rests on.

As already said, figures of living things naturally face the front, while other objects are posed in the way in which they can best be seen. Flat objects, such as roundles, roses, portcullises, and so forth, may be placed across, or fore and aft, as seems best in each case, both sides of the object being assumed to be painted with such details as may be necessary. With regard to crests, it should be remembered that the essential point is always complete legibility, combined with a definite and reasonable relation to the helm and to the rest of the composition.

Fleur-de-lis crests were sometimes made in a very effective way by two of them being made to intersect each other at right angles like a vane, so that the complete form of the object was visible from every point of view.

As an effective support for the crest, the Helm next demands attention. Following the same plan as before, we will first consider its

Fig. 19.



actual structure, so that, knowing the principle on which it was formed, we may be able to design any number of helms and so be spared the necessity of repeating one form too often, or of finding a new model for every fresh need.

With regard to this and other parts of armour (and much of it occurs in heraldry, from the mailed hand as a crest to the complete suit of a figure supporter) you cannot do better than acquire a good working knowledge of the actual thing, the practical reasons for the form of its parts and the manner of their working. By so doing you will learn to handle the subject with confidence, so that light and shade and the harmonious co-relation of lines may be secured, while the structure appears convincingly right. When heraldic crest devices were first applied to the mediæval helm it was to one something like Fig. 19, which is reproduced after Viollet-le-duc from a thirteenth century MS.

At first the helm was short and was worn on and supported by the head over the camail. It was provided with eye-slits or occularia, which were reinforced with an additional plate that was usually in the form of a cross, a feature which may be varied and elaborated at the ends to a very decorative extent. You may be interested to know that the endeavour to lessen the weight, without weakening the defensive power, caused the back plates to be made thinner than the rest. This is one of the means of detecting forgeries, by the way. By the end of the fourteenth century the efforts to find a more perfect defence had resulted in the various forms of helmet, the small helm lighter and with movable parts, that was less fatiguing to wear than the great

Fig. 20.

helm, which from that time forward was reserved for the tournament. The tournament helm for this purpose was much strengthened, was made longer until it rested on the shoulders, and so became a part of the body armour, to which it was firmly fixed, back and front, by straps and buckles. By this means the head was relieved of the weight, which was transferred to the body, and so the use of large crests as well as strong helms became possible. (Fig. 20).

Helms were of many shapes, which were, at the same time, but variations of the same general structure. The slope of the crown plate took different angles, the projections of the front plate increased, with consequent variation in the line of the middle ridge, and so forth. This bold strong line is of great importance in the composition of groups, in linking together the crest and the shield. Sometimes the lower edge of the helm spread out into a large gorget, and to it were rivetted the various attachments by which it was fastened to the body armour.

The breathing holes in the front plate were nearly always on the right hand side of it, for the attack being from the left, it was desirable that any hold, however slight, for a spear head, was to be avoided on that side as much as possible. With a similar object it was particularly directed in the instructions to armourers that the rivets of a helm should be sunk or filed, so that the coronal of the lance should obtain no hold. The breathing holes were often pierced in some decorative order, such as the shape of a fleur-de-lis ; but the huge cruciform opening that is sometimes drawn, like an arrow-slit in battlemented masonry, never occurred on a helm, and has no warrant, either actual or artistic. Behind the vertical join of the front and back plates other holes were pierced of various ornamental shapes, round or long, so that the knight might hear and, by turning his head, even see and speak to him who handed him his lance. These may also be of considerable decorative value in heraldic design.

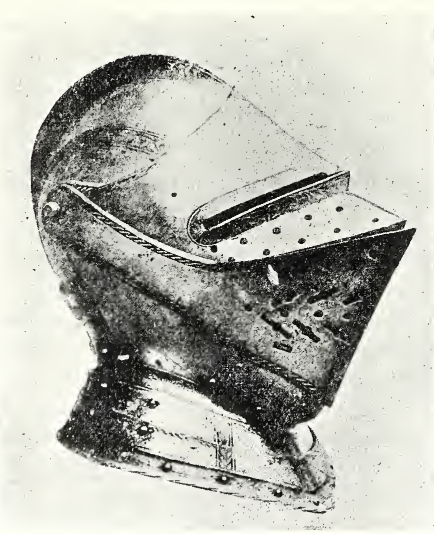
The central position of the helm in the heraldic group, a position in which it is, as I have said, of great value, both as a support for the crest and as a link with the shield, has, however, the disadvantage of tending to over-emphasise it, and this must always be taken into account. In painting, there will be no difficulty in bringing it into proper keeping, especially when it is remembered that helms were sometimes themselves painted and their rivets gilt.

In certain forms of black and white, such as strong simple line, the perforations and structural lines will be found very useful in supplying decorative detail that will also tend to lower the general tone. The perpendicular join at the side may also be ornamented, of course, in a metal-like way, as by filing into cusps the spaces between the rivets, and the latter may become small bosses. The value of such detail is well shown in most of Dürer's heraldic engravings. He, of course, knew perfectly what he was about with armour, as may be seen in the Death's-head Coat-of-arms, and in the Coat-of-arms with a Cock. The helms in these compositions are almost identical with the actual tournament helms that Dürer de-

signed to the order of the Emperor Maximilian. Another point which keeps the due relations of the helm is its forward tilt, which produces a strong tone on the part of the helm that is between the eyes-holes and the gorget. This tilt is due to the fact that the highest point of a helm is considerably behind its centre, and, therefore, when the helm is fixed on the top of a staff or stake, it naturally tilts forward, while at the same time the crest is brought upright. In the tournament helm there are holes in the crown plate, some of which were for fixing the crest and mantling, others being to secure a lining in the helm.

The great helm was that which was usually represented in connection with crests down to the sixteenth century, and is by far the most satisfactory in every way. It was always

FIG. 21.



represented in profile, or nearly so, down to the first half of that century, and it therefore displayed the crest in a very satisfactory manner. With the cessation of the tournaments, real touch with early heraldry was soon lost, and the Helmet, the lighter and more flexible head-piece, took the place of the helm in contemporary heraldic art. Fig. 21 shows one of these helmets, with its movable visor and flexible neck. It was actual battle armour, and was usually ornamented with a plume of feathers, for which a socket was fixed at the back just above the gorget. About the same time began the over-elaborations of heraldic rules, and it was arranged that the helmet should signify the rank of its bearer by its pose, and so we got to the present official rule—that an esquire's helmet is in profile with visor closed and is of steel with gold ornaments; that of a knight is of similar form, but full faced, with vizor open; a peer's helmet is protected with gold bars, and is in profile; while that of the Sovereign is all gold, is barred, and full faced. It was also attempted to make the number of bars denote exact rank, but fortunately that effort failed. There is really no necessity for anything of the kind, except in the case of a knight. A peer is perfectly distinguishable by his coronet, as the King by his crown. The reversion to the great helm in heraldic art began with Foster's Peerage, and is, happily, now well established.

Unlike the closed helmet, the barred helm, as a crest support, has the sanction of actual use, being derived from the special headpiece which was used in the tourney, as distinct from the joust—the duel with lances, as already indicated. The tourney was fought between bodies of men armed with blunt and pointless swords or with maces, and the armour for it was modified accordingly. Not only was the front of the helm given a very large opening, protected by a form of grille, but it was perforated here and there, in order to lighten it. Very often it was made of strong leather instead of metal, and was, in fact, the mediæval predecessor of the modern singlestick helmet. On this model other helms of leather, intended for purely ornamental or ceremonial purposes, were made, and were richly elaborated. And thence came the modern form of barred helmet that is used over the Arms of Peers.

In the usual group of shield, helm, and crest, the helm usually faces to the left, that is to say to its own proper right, the dexter side, but this is not necessarily so, if there is any reason for the contrary position—such as its occurrence in a book border, when it might help the general composition of the page to face the arms inwards.

In architectural decorations, it may be advisable to face all the helmets of a series in one direction in relation to some central point, and they are often so treated in early works. Armorials in a chapel, for instance, often face towards the altar, and in domestic decoration they turn towards the fireplace.

When two or more crests are ranged above a shield, they are usually faced inwards, towards each other, with great advantage to the composer of the armorial group. If, however, it is desirable to face them all one way, in relation to the composition of a larger

design of which they form a part, there is no heraldic objection to interfere with such a course. In other words, you may pose helmets in any way you think fit, except the full-faced position, which may be fairly reserved for those who are entitled to it under the ordinary rule. In German heraldry the the charges of the shield are also made to turn the reverse way on occasion, and those on quartered arms are sometimes made to turn towards each other on the same shield. Both methods are, however, contrary to English practice, and should be avoided.

In addition to the tournament helms and their derivatives, many other headpieces were sometimes used to support crests, such as the salade on the medal of René d'Anjou in the fifteenth century, but this instance may be ascribed to the influence of the classic style, towards which all were looking at the period, rather than to heraldic suitability. Salades came between the helms and the helmets, but are rarely used in heraldic design. most of the existing instances being found in German work.

From the helmet the Mantling starts, covering its crown and hanging at its side, in some one of the immense variety of its ornamental forms. Heraldic rules have nothing to do with the form of the mantling, only with its colour, and the great freedom of treatment thus made possible is, of course, extremely valuable.

At first a piece of plain drapery, used to protect the helm from the sun, an expedient that was perhaps learnt by the Crusaders, the mantling soon became elaborated into decoration of much grace and beauty. First it followed the fashions of other drapery of its time in having dagged edges, and thence it developed into purely decorative forms. An example of the late sixteenth century as it appears in this slide is remarkable for the beauty of its drawing, as was noted by Mr. Lewis Day in his book on Windows, in which it is reproduced.

In actual use, even at a tournament, the mantling probably remained comparatively simple; but in carving, in painting, and in enamel work it got quickly into touch with the other ornamental tracery of its time, and was thus enabled to perform its part in decoration in a very ornamental and satisfactory way. In a panel for instance, the mantling issuing from the helm may cover the space so as to form a beautiful background. It may, of course, be made to cover other spaces equally well. The principle on which much mantling is designed is to be seen more clearly on some of the brasses, where, hanging from the helm, it divides into two or more main branches, which again divide, generally in threes, and so on, terminating in triple foliations, which twist and fold over in endless variety.

Mantling has followed in its character every conceivable style of flowing ornament, and is perfectly free to do so. Italian heraldry, which influenced our later designs so much, made great use of the acanthus motive, and resulted in a form that has greatly influenced the mantling of the last three centuries. Something of this can be seen in the panels of the Palazzo del Podesta, in Florence. Here it will also be noticed how the foliations of the mantling may partially cover the helm and prevent it becoming insistent. In some cases the mantling was looped up at the side in festoons.

The treatment of mantling as ornamental form should be such as to support and supplement the shield and its bearings, and to assist in linking together the whole composition. Endless variety will be found possible in its design, and also in the way in which its lines may help each other in direction and force. The facility of twisting the main parts and of folding over the edges and ends, is extremely useful in correcting balance and adding detail, as well of form as of colour; twisting and folding in this way being practically without limit. Such details must, of course, be designed to assist the swing and flow of the whole thing, or else be in obviously intentional opposition in crossing over; otherwise, they will be confusing and worrying.

As to the colour of mantling, the only point on which heraldic rule has anything to say, the matter is very simple, so far as relates to modern memorials and to English use, viz., that the mantling follows the tinctures (the first colour and first metal) of the arms, whether of peer or commoner. Thus, if there are but two, there can be no question, but if there are more, the first colour and the first metal that are mentioned in the blazon govern the mantling.

The mantlings of the King and of the Princes of the blood are exceptions, those of the Sovereign and of the Prince of Wales being of gold lined with ermine, and those of the other Royal Princes are also of gold, but their lining or doubling is white.

Formerly peers used mantling of their colour lined with ermine, and this is still the Scottish

practice. Those who deal with colour, especially, perhaps, the glass painters, will, no doubt, resent this restriction, but I fear that it cannot be helped. The quality of the colour is, however, at their disposal, so that one may paint the mantling in lower tone than the shield in order to emphasize and make brilliant the central motive, or otherwise treat it as in one's discretion may be thought fit. The colour side of mantling may be decorated with lines and veinings of gold, as is done with charming effect in embroidery, and in addition powderings of badges may help to give a rich and decorative effect. There are many instances in early stall plates, and there is no heraldic reason against the modern use of this method of obtaining diversity of colour and interest.

The mantling being laced to the helm, and the crest fixed in position at the top, a torse of twisted silk was, as you know, placed round it. This is the wreath which has been so hardly treated in modern times, generally as though it were the edge of a shelf on which the crest rested, instead of being, perhaps, a lady's favour.

In present design the colours of the torse follow those of the shield, and consequently, of the mantling.

STATISTICAL ABSTRACT OF THE UNITED KINGDOM.

The Statistical Abstract for the United Kingdom (Cd. 3092), covering the fifteen years 1891 to 1905, opens with tables showing the amount of the estimated and actual revenue and expenditure of the United Kingdom, and the surplus or deficiency of revenue in each year from 1891-2 to 1905-6. The revenue has increased from £90,994,786 in the earlier years to £143,977,575 in 1905-6, and the expenditure from £80,927,773 to £140,511,955. The revenue from Customs has risen from £19,736,000 to £34,475,000, which is less by £1,255,000 than for 1904-5; from Excise from £25,618,000 to £30,230,000 again a reduction of £540,000 upon the preceding year; from Property and Income-tax from £13,810,000 to £31,350,000; from Post-office from £10,150,000 to £16,880,000; from stamps from £5,457,584 to £8,180,000; whilst the receipts from Suez Canal shares and sundry loans have increased from £222,111 to £1,098,594; but those from the Land-tax have fallen from £1,050,000 to £720,000. Particulars of Customs receipts show that the tax upon coal exported, levied for the first time in 1901-2, and producing £1,311,706, yielded in 1905-6 £2,183,973; the duty upon sugar, first imposed in 1901-2, and yielding in that year £6,399,228, being slightly less in 1905-6, at £6,177,953. The yield from tobacco and snuff duties increased from £9,948,810 in 1891-2 to £13,390,878 in 1905-6, and from tea from £3,418,162 to £6,814,908; but the receipts from wine fell from £1,291,052 to £1,175,089, and from spirits, foreign and colonial, from £4,429,904 to £3,724,357. Under the head of Excise the figures show an increase in the receipts from beer of from £9,457,749 to £12,564,075, and from spirits from £15,693,631 to £16,953,179; but in the receipts from beer there has been continued shrinkage since 1900-1, when they amounted to £13,490,620; and in 1899-1900 the receipts from spirits were £19,335,360, the shrinkage being continuous since that year with the one exception of 1902-3.

On pages 41 and 42 of the Abstract will be found the gross amount of certain classes of income brought under the review of the Inland Revenue Department in each year from 1891-2 to 1904-5. These figures show that in the period named the assessment of land has fallen from £57,391,846 to £52,257,990. The fall in England has been from £41,129,907 to £36,696,228, and in Scotland from £6,318,581 to £5,828,394, but in Ireland only from £9,943,358 to £9,723,377. On the other hand, "Horses, &c.," have risen from £143,146,177 to £201,572,703, the increase in England being from £125,945,646 to £177,665,512, in Scotland from £13,425,504 to £19,075,518, and in Ireland from £3,775,027 to £4,831,673. The profits of "Business, Professions, &c.," have increased in England from £229,173,045 to £315,570,425; in Scotland from £25,993,341 to £39,669,953, and in Ireland from £8,752,706 to £10,523,042. The increase in the salaries of Government officials in England is noteworthy. In 1891-2 this item of expenditure was £16,060,000; in 1904-5 it had grown to £20,995,175. In Scotland the increase has been much less in proportion, from £291,475 to £301,075, and it is a little surprising to find that in Ireland there has been an actual decrease, from £1,043,404 to £1,028,844. The increase in the salaries of corporation and public company officials has been very much heavier in all three countries, but here, too, Ireland shows the smaller proportional increase. In England the expenditure under this head has risen from £27,178,032 to £57,661,275, in Scotland from £3,459,230 to £6,694,584, and in Ireland from £1,423,808 to £2,693,334.

Similar expansion is to be seen in the figures of local expenditure, taxation, and indebtedness. In 1889-90 the outstanding loans of local authorities amounted to £198,671,312; in 1903-4 they had grown to £393,882,146, or considerably more than half the National Debt. Of this sum £187,100,454 is represented by baths, cemeteries, electricity supply, gas works, harbours, piers, docks and quays, light railways, markets, tramways, and waterworks. The expenditure in relief of the poor increased from £8,434,345 in 1889-90 to £13,609,870 in 1902-3, the latest year for which the figures are given; the ex-

penditure of School Boards grew from £5,607,894 to £13,488,433; of town and municipal anthorities, for police, sanitary, and other public works, from £29,856,298 to £79,995,031; of Rural District Councils, from £625,534 to £1,799,632. The total of local expenditure increased from £55,268,127 in 1889-90 to £128,968,743 in 1902-3.

Passing to the value of the total imports of the United Kingdom from, and total exports to the principal foreign countries and British possessions, it will be found that the imports have increased from £435,441,264 in 1891 (giving a proportion per head of population of £11 10s. 5d.) to £565,019,917 in 1905 (a proportion per head of £13 1s. 5d.), the exports having increased from £247,235,150 (or £6 10s. 10d. per head of population), to £329,816,614, the proportion having risen to £7 12s. 7d. Taking the total of imports and exports, the proportion per head rose from £19 13s. 11d. to £22 10s. 1d. Taking the different countries, our imports from the Argentine Republic show greatest expansion. In 1891 they were valued at £3,451,228; in 1905 they had risen to £25,034,325, the increase being mostly in wheat of which in 1891 we imported from the Argentine 2,479,229 cwts., and in 1905, 24,093,067 cwts. Our imports from Russia, which in 1891 were of the value of £24,110,251, had increased in 1905 to the value of £33,366,234, or over 45 per cent., whilst our exports to that country had increased from £8,193,132 to £14,884,050. Our imports from Germany, taking the same period, rose from £27,031,743 to £35,799,758, and our exports from £29,944,361 to £42,742,300; our imports from the Netherlands, which, at the earlier date, were slightly in excess of those from Germany, in 1905 were a trifle under £35,481,059, but our exports to the Netherlands which, in 1891, were valued at £14,988,930, had actually fallen in 1905, being only £14,516,887. Our imports from France have increased from £44,777,460 to £53,072,900, but our exports to that country have shrunk from £24,336,676 to £23,232,663. Taking the total imports from foreign countries, they have increased from £335,976,546 in 1891, to £437,151,191 in 1905, and exports have increased from £215,755,599 to £284,883,607. Our exports to the United States show comparatively small increase in the period under review, namely, from a value of £41,066,647 to £47,282,088, imports have increased from £104,409,050 to £115,573,051.

Turning to the Colonies, our trade with Canada shows substantial growth. In 1891, the imports amounted to £12,103,493, in 1905 to £25,695,898, whilst the exports rose from £7,802,907 to £13,767,079. The imports from Australia increased from £23,068,972 to £26,968,977; but the exports fell from £24,453,359 to £19,476,463. The figures for New Zealand are more satisfactory, imports having increased from £8,192,594 to £13,391,222; and exports from £3,778,394 to £6,994,806. The imports from Cape Colony (diamonds excluded), were valued at £5,071,000 in 1891, and at only £4,909,116 in 1895, but the exports rose from £6,145,449 to £11,513,083. So with Natal. The imports fell from £1,183,428 to £632,346; but the exports increased from £2,493,088 to £6,326,284. Our trade with India shows rather small improvement in imports, from £32,234,398 to £36,062,291; but our exports to India increased from £32,549,207 to £44,361,153. Taking the whole of the British possessions, the imports increased from £99,464,718 in 1891, to £127,868,726 in 1905; and our exports from £93,338,119 to £122,712,920. Taking the total of foreign countries and British possessions together, imports have increased in the fifteen years from £435,441,264 to £595,019,917: and exports from £309,113,718 to £407,596,527.

Much is said about the coming declension of the Port of London, but present figures show that her position is well maintained so far as the ports of the United Kingdom are concerned. As in 1891 so in 1905 the tonnage entered far exceeds that of her chief rival, Liverpool. In 1891, it amounted to 7,637,965; in 1905 to 10,814,115; the Liverpool figures being 5,866,920 and 7,806,844 respectively. Cardiff comes next with 4,337,720 tons, Newcastle following close with 4,058,618 tons. In 1891, Newcastle was ahead of Cardiff, the figures being respectively 3,568,293 and 3,425,891. In tonnage cleared, London remains first with 7,913,115 tons as against Cardiff's 7,476,879 tons, London having materially improved her position in 1905, but the most striking increase is that of Dover which, in 1891, cleared only 818,045 tons; and in 1904, 1,755,921 tons; the clearances last year amounting to no less than 2,944,774 tons, due, of course, largely to Dover being made a port of call by the great German liners. Newcastle ranks third in the extent of its clearances with 5,158,899 tons. Both in number and tonnage, sailing vessels continue to decline. In 1891, the number of sailing vessels registered under the Merchants Shipping Acts, belonging to the United Kingdom, was 13,823, of a net tonnage of 2,972,093; in 1905 they had fallen to 10,059, of a tonnage of 1,670,766. On the other hand, the steam vessels had increased from 7,720, with a net tonnage of 5,307,204; to 10,527, with a net tonnage of 9,064,816.

In population, Scotland continues to increase her superiority to Ireland, first gained in 1901, when the population of the two countries was respectively 4,483,880 and 4,445,630; in the middle of the present year, the figures were respectively 4,726,070 and 4,386,035. The change in the position of the three countries, during the last sixty-five years, will be seen from the following figures:—

	England and Wales.	Scotland.	Ireland.
1841....	15,914,148	2,620,184	8,175,124
1906....	34,547,016	4,726,070	4,386,035

In 1841, the population of England and Wales was much less than half what it is to-day, and that of Ireland was more than three times as much as Scotland. Now the population of Ireland is half a million

less than that of Scotland, and not much more than half that of 1841. Since 1891, there has been a steady and unchecked fall in the birth-rate so far as England and Wales, and Scotland, are concerned; in the former from 31·4 to 27·2, in the latter from 31·2 to 28·1. In Ireland, the rate has been practically stationary, being 23·1 in 1891 and 23·4 in 1905. The death-rate has fallen in England and Wales from 20·2 to 15·2, and in Scotland from 20·7 to 15·9, but in Ireland, only from 18·4 to 17·1. Marriages show less change, in England and Wales only from 15·6 to 15·3, in Scotland from 13·9 to 13·4, whilst in Ireland they have increased from 9·2 to 10·4. The number of male and female criminal offenders committed for trial in England and Wales increased from 11,605 in 1891 to 12,689 in 1905; in Scotland from 2,354 to 2,811, whilst in Ireland they decreased from 2,112 to 2,060. The number of paupers in receipt of relief, taking one day in the winter, in England and Wales was 754,485 in 1892, and 909,918 in 1905; in Scotland, 93,051 and 111,202; and in Ireland, 103,376 and 103,302. Ireland continues to give the highest emigration figures in proportion to population. Of the number of English, Scotch and Irish passengers that left the United Kingdom for countries out of Europe in 1905, 170,408 were English, 41,510 Scotch, and 50,159 Irish. The corresponding figures for 1891 were 137,881, 22,190, and 58,436. The proportion going to the United States was somewhat smaller last year than in 1904, but of a total of British and Irish emigrants of 262,077, 122,370 went there. Canada comes next with 82,437, and the increase in the emigration to the Dominion is remarked. In 1901 it was only 15,757, in 1904 it was 69,681, last year 82,437. The emigration to Australia and New Zealand was 26,307—in 1903 it was 50,206—and to British South Africa 26,307. The total emigration last year to places within the British Empire was 132,962, the largest of any year covered by the Abstract. The expenditure from Parliamentary grants for primary schools in Great Britain has increased from £5,291,585 in 1891-2 to £13,516,348 in 1905-6, the increase in Ireland of the expenditure of the Commissioners of National Education from Parliamentary grants and rates being from £969,445 in 1891-2 to £1,466,574 in 1905-6.

COTTON CULTURE IN COREA.

Mr. Ando, expert in the Department of Agriculture and Commerce, Tokio, having been commissioned by the Association of Cotton Growers to make experiments in the culture of upland cotton in Corea, has now made a report to the Foreign Office (Cd. 2683) in which he says that he considers the prospects of the successful cultivation of upland cotton in Corea very promising. Should its cultivation be extended throughout the country it must prove a considerable factor in the improvement of its agricultural conditions, and will be of great value to the interests of the spinning industry in Japan. Upland cotton seems admirably adapted to the conditions, climate, and soil in Corea. In Japan, the excess of rain at the season of the bursting of the pod causes a certain amount of rot to set in, and consequently reduces the yield, but in Corea the weather at this season is dry, thus ensuring a safe crop. It seems that the time of flowering and of bursting of the pod is much the same in the case of both the native and the upland cotton, and the weather conditions are favourable to the plant at both these seasons. Upland cotton even if, as is the case with the native cotton, the buds and superfluous shoots are not pinched out, still gives a greater yield than the native plant. All cotton, if allowed to grow too freely, has a large proportion of buds which do not open. In Japan, in the case of both upland and native cotton, great care is taken to pinch out the superfluous shoots and non-bearing branches, but this is not done by the Corean farmers. Upland cotton not only gives a greater percentage of ginned cotton, but the fibre is longer and finer, and it is therefore much the superior plant. Mr. Ando gives calculations which show that there is a profit of some £3 16s. on upland cotton per acre as against native grown without manure. From this, however, must be deducted the cost of coolies employed to take off the shoots as they appear, necessitating the hire of about 40 days labour in the season, which at 10d. per diem would cost some £1 13s. 4d., leaving a clear profit of £2 2s. 8d. The gross value per acre of ginned cotton, taking an average for manured cotton at Mokpo, Mr. Ando puts at £8 6s. 11d. for upland cotton, and £2 4s. 8d. for native cotton. As a matter of fact, however, the upland cotton, having a longer and finer fibre, commands a higher price, and the difference in value of the two crops is really still greater.

Although accurate figures are impossible to obtain, Mr. Ando estimates the area cultivated roughly at 298,200 acres, or about 4·5 per cent. of the cultivated area of the country. Though the crop occasionally reaches some 500 lbs. of unginned cotton per acre the average crop is considerably less. Mr. Ando says that the experiments at Mokpo tend to show that the production of upland cotton throughout the country would increase the output of cotton by some 50 per cent, *i.e.*, the average crop per acre would amount to some 540 lbs., and the total crop of the country to between 150 million and 160 million lbs. With improved methods of culture the yield might be increased to about 800 lbs. to the acre, which would give a total crop of about 240 million lbs., with some 72 million lbs. of ginned cotton, which, at the same price, would give an increased value of over £800,000 on the existing return. Assuming the whole of the suitable and available land—at least 500,000 acres, or an additional area of 202,000 acres—were under cotton cultivation, Mr. Ando estimates that its value would be roughly £2,500,000, equivalent to almost five times the value of the crop in Corea under existing conditions.

THE LIVE STOCK OF AUSTRALIA.

There are in Australia, over 1,500,000 horses, some 10,000,000 cattle, about 66,500,000 sheep, and over 1,000,000 swine. The improvement in the breeding of the different varieties of stock has been especially great during the last twenty years, and infinitely greater attention is now given to the proper selection and breeding of horses, cattle and sheep, than was formerly the case. According to official statistics, New South Wales appears to possess the greatest number of horses, and Tasmania the least. In 1884, there were 337,172 horses owned in New South Wales, and in 1904 the number had increased to 482,663. The Victorian figures are—1884, 293,846 horses, and 372,397 in 1904. Queensland increased her number of horses in a much greater degree, viz , from 253,116 in 1884, to 418,165 in 1904. South Australian horses numbered 168,420, and 183,481 in 1904; and the Western Australian figures read—1884, 37,111; and 1904, 90,102, which is a large increase. In ten years, Tasmania's stock of horses rose from 27,188 to 36,565, during the same period, which may be taken as a very satisfactory record. In the case of cattle, progress is checked in New South Wales and Queensland, owing to drought, and the temptation to sell at the high prices obtainable in the southern markets. With these exceptions, the record for the Commonwealth is a satisfactory one, and in the Eastern States, the re-stocking and natural increase has been progressing exceedingly well during the last three years. For instance, in 1884, the cattle in New South Wales numbered 1,425,130. In 1894, ten years later, they had grown to 2,465,411, an increase of over 1,000,000—then gradually dwindled during the dry years. The year 1903, however, showed a substantial increase upon the previous year, and 1904 showed a further increase of over 300,000. At the end of 1904 they stood at 2,167,129, and the promise for the future is a very good one. The Victorian record is very similar—a great increase in the herds from 1884 to 1894, and then a gradual diminution, followed of late years by satisfactory expansion, until, at the end of 1904, Victoria possessed 1,694,976 cattle, an increase of over 150,000 as compared with the previous year. Queensland owned 2,722,340 cattle at the end of 1904, an increase of over 230,000 as compared with 1903. South Australian cattle, at the end of 1904, numbered 272,459, exclusive of the Northern Territory. West Australia shows the greatest increase—*i.e.*, from 71,102 in 1884, to 560,914 in 1904. Tasmania also has increased her herds from 128,834 to 202,206, a slower but still satisfactory increase. As regards sheep, New South Wales, in 1884, owned 31,660,321, and in 1904, 34,526,394. Victoria's figures show a slight decrease, from 10,637,412 to 10,167,691, a drop of nearly 50,000. Queensland has shown satisfactory growth in its flocks during the last three years. In 1902 the numbers were a little over 7,000,000, whilst the last return showed 10,840,470, an increase of over 2,500,000 in two years. Queensland stands second on the list of wool producers in Australia. South Australia comes fourth, with 5,820,301; West Australia owns about half that number, 2,856,200, and Tasmania claims 1,556,460. The grand total of Australian sheep at the end of 1904 numbered no less than 65,038,722.

BRITISH AND AMERICAN MACHINERY EXPORTS.

In a monograph recently issued by the United States Department of Commerce and Labour on the subject of the exports of machinery, and the persistent rivalry for markets of the world, it is stated that of American manufactures machines and machinery constitute the premier export of the United States amounting in 1904 to £17,100,000, being the largest export of any one country save the United Kingdom, the exports of which amounted in the same year to £21,360,000. As regards the competition of the United Kingdom with the United States in the matter of machinery exports, it is the opinion of the writer of the monograph that the lead of the former country in the value of its exports of machines and machinery is wholly due to its large shipments of textile machinery, a branch of the machine trade wherein the United States has no recorded exports, while the latter country is fourth on the list of countries to which the United Kingdom exports textile machinery, coming after Germany, France and Italy. In 1904 the exports of British locomotives amounted to £1,950,000, while the exports of American locomotives amounted only to £1,060,000. This difference was due to the large British exports to British India, British Africa, Australasia and Argentina, whose railways are controlled by British interests. The large exports of American locomotives to Canada (£354,000 against £760 British) is accounted for by the fact that Candian railways are worked on the American system as indeed are all Canadian industries. The manufacturers who first introduce their locomotives into any country, especially those countries which have no forcible public opinion to demand, and enforce the demand for the best service realise great advantages thereby. Engineers and firemen become used to machines and thus a prejudice exists against any change. Indeed the engineers and firemen in such cases have been introduced to run, and show the natives how to run, the locomotives. Besides, the capital which built the roads, and which in most cases still controls the roads, is British, and, of course, intensely interested in British rolling stock. While the United Kingdom exported steam agricultural engines to the value of £906,000 in 1904, there is no special record of like engines from the United States. British steam engines, other than locomotives and agricultural, were exported in 1904 to the value of £2,910,000, against £648,000 in the case of similar machines exported from the United States Steam engines of all sorts, locomotives, agricultural and other, consti-

tute but a very small part of American exports of machines and machinery, amounting in 1904 to only £1,700,000, against the export of similar engines from the United Kingdom valued at £4,900,000. Passing from steam engines to agricultural machines and implements, the monograph states that, while American exports amounted in 1904 to £4,549,000, the value of the British agricultural machines was only £1,100,000. Argentina was the principal country to which American exports were sent, followed by Canada, which is the next best market for American agricultural machinery (£672,000). These countries are followed by Russia and France, the United Kingdom coming fifth on the list of consumers of American agricultural machinery and implements. Sewing machines being as much an American invention as are agricultural machines and implements—more so in fact—it is curious to find that the exports of sewing machines from the United Kingdom in 1904 were nearly double in value the exports from the United States, and would have been very much more than double were it not for American exports to the United Kingdom itself (£266,000), Australia, and Canada. About 80 per cent. of American sewing machines went to the United Kingdom, Germany, Argentina, Mexico, Australia, Canada, Cuba, and Japan—a total to these countries of £968,000, against £201,000 from the United Kingdom. On this point it is stated that some understanding must exist between American manufacturers proper and the American manufacturers who have established factories in the United Kingdom, otherwise the fact that British sewing machines were exported as follows would be inexplicable:—To Russia, £880,000, against £7,520 from the United States; to France, £243,000, against £29,000 from the United States; to Italy, £146,000, against £5,620; to Austria-Hungary, £107,000, against £1,340; to Spain, £107,000, against £2,600; to Turkey, £80,000, against nil; to Sweden and Norway, £65,000, against £120; to Belgium, £64,000, against £6,200. These figures, in the opinion of the writer of the monograph, argues that some understanding must exist among the American manufacturers in the United States and the "American" manufacturers in England on the division of territory. The exports of American electrical machinery in 1904 were threefold those from the United Kingdom. The largest exports from the United States were to Canada, Japan, and Mexico. This not only shows the advanced position of the development of these three countries, but it also shows that the trend of all countries, eager to develop their industrial resources, is towards the employment of electrical machinery. Unless some power superior to electrical energy should supervene, electrical machinery and electrical appliances of all kinds will dominate the industrial future. It is to be regretted that no special record is made in the American official publications of mining machinery exports, for there is undoubtedly a large export from the United States. There is, therefore, no way by which the value of such exports, or the enumeration of the countries to which directed, can be given. It is, however, likely that most of the machinery not specially designated exported from the United States to South Africa, Australia, Mexico, &c., is mining machinery. The exports of mining machinery from the United Kingdom in 1904 were valued at £900,000, of which the greater part went to British colonies and possessions. In the case of textile machinery the United Kingdom is dominant, and, from all appearances, is likely to remain so, as the most advanced manufacturing countries in nearly all other products are her best customers. Long before other countries had advanced in manufactures, the United Kingdom was forced into this textile machine manufacture to supply her own vast wants, and these once supplied, she was ready to supply the needs of other countries, who found it more convenient to purchase their textile machinery and produce their own cloths, rather than undergo the expense and delay incurred in manufacturing their own textile machinery, until now both the manufacturing countries and the countries just developing their manufactures rely upon British textile machinery to a very large extent—to the extent of £5,000,000 in 1904.

GERMAN COLONIAL TRADE.

According to statistics recently prepared by the "Strassburger Neueste Nachrichten," Germany's imports from her colonies have increased from £338,000 in 1902 to £881,000 in 1905, and her exports to the colonies from £1,347,000 in 1902 to £2,160,000 in 1905. German West Africa exports more to the mother country than any other colony, and German East Africa stands next in rank, having almost trebled her sales to Germany during the past three years. No statistics are at hand showing the actual value of different groups of merchandise exported from the colonies, but from the amount by weight of each product fairly accurate conclusions can be arrived at. From German East Africa, rubber is the leading article of export, 874,720 pounds, worth about £64,000, having been shipped from there in 1905. Beeswax comes next with 797,620 pounds, valued at £20,000. The exports of coffee from German East Africa have fallen off from 899,580 pounds in 1902 to 795,880 pounds in 1905. Guano, which occupied a prominent place among the exports from South-West Africa, has no longer any importance. The Camaroons and Togo have only begun to export anything of importance during the last year. The exports from the former amounted in value to £446,000, and from Togo to £54,000. Rubber occupied here, as in German East Africa, the principal place, 2,220,020 pounds having been exported, valued at £330,000. Palm nuts and cocoa beans were shipped in great quantities to Germany. Ivory shipments amounted to 60,940 pounds, worth about £8,000. There are no statistics from Kiantschou for 1905, but in 1904, coal for the first time figured among the exports

along with ox-hides. Shantung coal was exported to the value of about £500. Copra is the principal export from Samoa. The imports since 1904 from the colonies have increased nearly 58 per cent. The exports from Germany to the colonies have naturally been much heavier than imports from them. In 1902, Germany sent to her colonies goods to the value of £1,046,000. In 1905, these figures increased to £2,160,000. To South-West Africa she sent in 1905, £913,000 worth, as against £228,000 in 1902. With Samoa, during the same period, Germany's trade decreased from £25,000 in 1902, to £22,000 in 1905. The other colonies occupy intermediate positions in importance between these two, ranging from East Africa, West Africa, and Kiautschou to German Australasia, West Africa and Samoa are the only colonies sending more to the mother country than they receive from her. Among the articles shipped to the colonies—iron, textiles, and beer occupy the first place in weight. Then follow the precious metals, silver leading. East Africa in 1905 took alone over £101,000 worth. Minted silver to the value of £35,000, and £30,000 of minted gold was sent to the Cameroons. Steel rails and ties were shipped to East Africa to the amount of 27,182,000 pounds in 1905, as against 7,969,000 in the preceding year. The exportation of locomotives, iron bridges, and machinery to East Africa, all showed a heavy increase during the year. Naturally, provisions and necessaries for the troops in South - West Africa played an important part in the exports to that colony during 1905. Flour, butter, wine in bottle, sausages, cigars, table delicacies, and beer were important articles of export. The entire increase in exports to South-West Africa in 1905 can be credited to necessaries for the troops. Railway supplies and iron products all show a decrease during the past year. To West Africa, the principal exports were heavy cotton goods, rough iron, knives, and coal. Here the exportation of certain articles, such as bottled beer and gunpowder, show a decrease as compared with preceding years. German Australasia takes only textiles, ironware, and bottled beer in appreciable quantities. Samoa purchases dress goods, building materials, and lumber, but Germany's exports thither show a falling off since 1902. On the whole, Germany's commerce with her colonies shows a decided increase, and is very encouraging to the mother country.

CHINA'S NEW EDUCATIONAL SYSTEM.

The first new educational step of the Peking Government was in 1903, when a commission of one Manchu and two Chinese high officials was appointed to study the whole situation and report as to the best course for China to adopt. The old method of conferring literary degrees, by holding biennial and triennial examinations, as a means of encouraging self-education, was abolished in November, 1905, the authority to confer degrees being now vested in the university and colleges to be established under the control of the Government in Peking. According to the American Consul at Amoy, a Board of Education has been created in Peking to devise means of introducing Western education, and an elaborate system of schools of different grades has been initiated. The plan is to have one or more elementary schools in every magistracy, middle schools in prefectures, colleges at the capitals of the provinces, and university at Peking, besides normal schools for teachers at points where it may be advisable. In view of what Japan has accomplished in recent years, China has looked to Japan for a model and for help, and it has openly been announced by Chinese statesmen that their aim is to model the university of Peking on the plan of the Tokyo University. Education is not compulsory under the present law. Chinese boys seven years old are eligible to enter elementary schools, which are divided into two grades, the first and second, with a five and four years' course in each grade respectively. The course in the first grade elementary school includes eight different subjects—moral training, Chinese classics, Chinese literature, arithmetic, history, geography, sciences, and gymnastic exercises Besides these, the second grade elementary schools include drawing as a ninth subject. No foreign language is taught until the boy is admitted into the middle school. The five-year curriculum in the latter includes foreign languages, which may be Japanese, English, German, French, or Russian. It also includes physics, chemistry, and political economy. After graduation he can apply for admission to college, where in three years he is fittted for the university, in which specialised courses of law, medicine and surgery, agriculture, literature, &c., are given. English is compulsory in the college, other foreign languages being elective. The courses in the university as planned, represent a high order of practical, technical, and professional instruction, but at present the matter has scarcely gone beyond the theoretical stage, the university lacking apparatus and instructors, its proposed housing being converted temples and examination halls. The schools now existing in line with this plan of education are supported largely by fees, by special local taxes, by gifts from wealthy people, and by any other means which may be possible. In some provinces a certain portion of the general taxes are set aside for the establishment and maintenance of these schools. Tuition is charged for in practically all schools, however, and the support of nearly all these institutions is more or less precarious and unsatisfactory. The result of this new system of education ought to be a constantly increasing demand for all classes of foreign goods, for foreign books, instruments, and appliances, for machinery of all kinds; in short, for all those articles of foreign manufacture which go to make up present-day Western civilisation. A general demand for such goods from China need not be expected in a day, but the demand will come in due time.

HOME INDUSTRIES.

The Dairy Show.—The thirty-first annual Dairy Show, held at Islington, and brought to a close on Friday last, was visited by an unusually large number of persons, and was an excellent exhibition. The total of 6,221 entries of live stock has never been approached in any previous year, but it is in the pigeon and the poultry classes, more especially the latter, that the greatest increase is to be found. The cattle entries, although very much larger than last year—240 as against 182—have before now numbered over 300, but the falling off in these entries is explained by the much greater stringency of the conditions. As a whole, there were fewer entries of dairy products—875 as against 961 in 1905—but the standard reached was unusually high, and it must be remembered that the season has been against this section of the show. In the miscellaneous entries, milk-bread entries show the greatest increase—159 against 121 in 1905—and this division was admittedly the best illustration of how bread and scones may be made with milk that has ever been put before the visitors to a dairy show. But perhaps the most progressive section of the exhibition covered the contests, tests, and competitions. The advance in the number of entries was considerable—as from 485 to 567—and the milkers' contests, a feature of much value and attractiveness, nearly doubled—as from 62 to 121. Altogether, there were nearly 2,000 exhibitors, and the prize money exceeded £2,400. An exhibit of great interest and practical importance was that of Swiss animals in the goat class. They had a class to themselves, and deserved it. These goats yield a gallon of milk a day for long consecutive periods, and it is surprising—or would be if the slowness of the English farmer to move from beaten ways was less well known—that British agriculturists, more especially in hilly districts, do not resort to them more generally. The British Goat Society has done much during the last twenty-five years to raise the standard of milk production. Four gallons of milk a week used to be considered a very good record, now the Society expects five gallons from a good animal. But the Swiss goats produce no less than seven gallons a week, and some exceptional animals give nearly eight gallons a week. Now a healthy goat, of good strain, can be got for £10, and will yield milk from March to October inclusive. In the eight months it may be relied upon to give, say 160 gallons of milk, and this, putting the value as low as a shilling a gallon, means £8, so that the animal will almost pay for itself in a single year. Why do not the small farmers of the United Kingdom keep these goats? As it is, they do not touch milk. They consider it outside their means, and so, of course, it is in most cases if cows only are considered. Cows mean capital, capital to buy them and to house them, not to speak of the land to feed them. But goats can be got at a very small expenditure, no buildings are wanted, and they are of the hardiest. To take England only, there are 81,232 agricultural holdings above one and not exceeding five acres; there are 166,622 agricultural holdings above five and not exceeding fifty acres. These petty culturists produce little or no milk for the reasons given, and yet there is a home market ready for all they can supply, at a price that would give them a handsome profit. The smallest of these holders could keep a goat, those with more land could keep many; goat's milk is of high feeding value; the price to be got for it would would leave a good margin of profit. Yet so little is thought of the goat by those who seek a living from *petite culture* that the agricultural returns give no separate heading for goats. They show the number of "horses, cattle, sheep, and pigs," but of the goats they are silent.

The Colonies and the Exhibition.—Some of the Australian colonies were well to the front in their exhibits of butter. New Zealand was at some disadvantage as compared with New South Wales and Victoria, owing to the comparative lateness of the New Zealand season, but the colony had an attractive advertisement in the shape of New Zealand butter exhibited in a glass case, and comprising all sorts of designs in butter. It is astonishing how well the butter retained its shape notwithstanding the unusally high temperature. Some of the Australian butters were of very great merit, and must have been viewed with very mixed feelings by English butter makers, already subject to European competition of great severity. The recent rapid growth of the imports of butter from Australia may be gathered from the following figures:—

	1901. Cwts.		1906. Cwts.
New South Wales....	59,597	..	168,531
Victoria	186,141	..	227,579
Queensland	53	..	54,188
South Australia	2,377	..	8,761
Western Australia....	—	..	279
Total for Australia....	248,168	..	459,338
,, New Zealand	167,343	..	300,415

It was disappointing and surprising not to see the Dominion represented. The imports of Canadian butter increased from 215,505 cwts. in 1901 to 292,117 cwts. last year, and great importance is naturally attached in the Dominion to the expansion of this trade. It might have been thought, too, that Natal which, for the first time, last year sent us 870 cwts., would have wished to be in evidence.

Hops and Brewers.—The preliminary statement, just issued by the Board of Agriculture completely confirms the pessimistic estimates of the hop crop to which attention has been directed in these notes. The returns show that the total produce of the hop-growing counties is not expected to exceed 245,688 cwts., against 695,943 last year, the acreage under cultivation this year being 46,722, as against 48,967 in 1905, and the estimated average yield per acre 5·26 cwt., as against 14·21. All the counties have suffered about equally, the fall in Kent being from 443,470

cwts. to 166,631. It is believed that the crop in the aggregate has cost about £10 per cwt. to produce, say, taking the average, about fifty guineas per acre, the average over a series of years being about £40. On the other hand, market prices remain very low, not much more than half the cost of production. How long they will remain so, and to what extent they will improve, must largely depend upon the stocks on hand from last year's crops, and as to that there is very considerable doubt. It is alleged that "substitutes," or "supplements," and chemical "preservatives" are being used by the brewers much more than heretofore, but we are not aware of the existence of convincing evidence. When these allegations were inquired into by the Parliamentary Committee that sat some years ago they were held to be not proven. Of course, the quantity of hops imported from abroad is influenced by the home crop, but not so closely as might be thought. In 1870, when the acreage under hops was 55,961, as against 46,722 acres this year, the average yield per acre was exactly the same as this year, namely, 5·26, and in that year 188,028 cwts., of a value of £877,704, were imported, the home product being 283,679 cwt. But in 1904, when the home product was much the same, namely, 282,330 cwt., no less than 313.667 cwt., of a value of £1,839,854, were imported. It is true the population in the interval had increased from 37,484,764 to 42,789,552, but the clearings of barrels, *per capita*, has fallen from 30·00 to 28·77, and the actual increase in the clearances of barrels, was only from 31,236,818, to 34,224,685. Last year the home product was 695,943 cwt., and the imports of hops fell away to 108,953, but the two together made a supply of 804,896, as against 595,997 cwt. in 1904; and yet in 1904 the total clearances of beer amounted to 34,224,605 barrels, as against 33,250,654 in 1905. It would seem, therefore, reasonable to assume that the brewers still have on hand very considerable reserves from last year's home crop, and if that be the case it is not likely that the price of hops will rise to anything like the rates which in years gone by went far to compensate for short yields. It is to be feared that a considerable acreage will be grubbed this year, and it is not likely to be replanted. That this should be so is much to be regretted from the consumers' and labour point of view, nor are the brewers likely to be advantaged when they have to rely almost entirely, as they may have to do, upon the foreign product.

A Shipbuilders' Steel Works.—The shipbuilders of the Clyde are threatening to start steel works of their own, and actual steps have been taken towards formulating a scheme. Whether it will be proceeded with would seem to depend upon whether the causes of complaint against existing producers are removed. The shipbuilders complain, and have been complaining for the last two years, that Scotch steelmakers and other producers have been giving preference in prices to consumers in the Belfast and other home markets, and also to buyers in foreign markets. According to the Clyde shipbuilders they have to pay more for plates and angles than their competitors in other centres in the United Kingdom and abroad. The shipbuilders say that steel makers have taken up an antagonistic position, which makes it impossible for the Clyde shipbuilders to hold their own against their competitors. Nor is it only an angle, ship, and boiler plate combination with which they have to reckon. There are, according to the *Economist*, local selling compacts in existence between tube makers, makers of forgings, condensers, bar iron makers, and others, and one and all have a fixed and relatively high level of minimum prices below which they will not part with material to consumers in their own immediate neighbourhood—on the river and in the district. "But to all and sundry beyond the area of the Firth of Clyde they are prepared to, and do sell at whatever terms can be conveniently commanded, and that means that concessions will range from 5s. to 20s. a ton." According to the shipbuilders this enables the North of Ireland shipbuilders to take nearly £2,000 less on a 7,000 ton boat than could be accepted on the Clyde, and to make a fair profit on the contract. The steel makers deny that they have taken up an antagonistic position to the local consumers, but the admitted facts would seem to point to a different conclusion, and if the allegations of the shipbuilders are sustainable it is not surprising that they should be meditating steps to put an end to a state of things that, if continued, must be destructive to the best trade interests of the West of Scotland.

Cotton and the Cotton Trade.—Last week cotton touched 6·45d., the highest price recorded this year. The reports as to the condition of the American cotton crop grow less and less favourable. Excessive rainfall and then frost is reported from many districts, and although no very serious damage is known to have been done the market is disturbed. Cotton is now a penny above the price of a year ago, and should further unfavourable reports be received it may well go much higher. At best the present American crop is not likely to exceed 12,000,000 bales, and that quantity barely suffices to give employment to the spindles of the world for a year. Meantime for the nine months ended September 30th last the total shipments of cotton piece goods exceeded those of 1904 and 1905, the figures for 1905 being 4,603,146,100 yards as against 4,748,715,106 for 1906. Turkey, the Argentine Republic, Colombia, Australia, the United States, and now India are increasing their orders and China is the only country showing a considerable decrease, being still oversupplied with cloth. The home trade too continues active, the great distributing houses being busier then ever in preparation for the autumn and winter trade. But the margin of profit is narrower. It may be noted too that we are sending this year considerably more textile machinery abroad than in 1904 and 1905. Taking the nine months ended 30th September the value of machinery exported in 1905 was £3,911,637

as compared with £4,810,730 for the same period of the present year, an increase in 1906 of over £900,000. New looms are still starting in Lancashire and new mill projects. There is talk of no less than six spinning factories to be built immediately in South Lancashire, and new weaving sheds are in contemplation. If only the weather becomes or remains fair in the American cotton States—the reports from other cotton-growing centres are not unfavourable—1906-7 bids fair to be a record year in the cotton industry.

The Strike on the Clyde.—The position on the Clyde in relation to the labour strike has not improved. The men remain insistent upon an advance of five per cent., and the employers are equally determined not to concede it. Indeed, if they were induced to do so under present conditions the men would be no gainers. The increased labour bill would compel shipbuilders to increase their rates for construction, and in the present state of the freight market shipowners would not pay them. As it is, whilst last month's launches on the Clyde reached a total of 102,000 tons over all previous records, the new contracts are proportionately below the average. Rapid construction is leaving the yards empty. In September the Clyde contracts did not exceed 8,000 tons, and even without the strike those for October would hardly have been larger. The only yards that have anything like a good prospect of work in the ensuing months when the current contracts are worked off are those which turn out specialties or very high class products. The builders of ordinary cargo tramps will soon be idle with little prospect, apart from the effect of the strike, of new orders. The present supply of tramps is much in excess of the demand. The strike could hardly have come at a more convenient time for the shipbuilders, but it is none the less regrettable. Moreover there is every likelihood of an extension of the strike to the Tyne where the men are making the same demand as that which the Clyde builders have rejected. Nor is it likely that the engine and boiler-shop men who find the funds to support the riveters and others now on strike will be kept on if the existing strike continues. The indications point to a general lock-out in the shipbuilding industry, an event that might well bring great calamity alike to masters, men, and the country.

GENERAL NOTES.

International Exhibition at Venice.—In his report for the year 1905–6 (Cd. 2682), Mr. Consul D. Zuccato refers to the Seventh International Art Exhibition which will be held in Venice from April 22nd to October 31st, 1907. It will be divided into Italian, Foreign, and International Sections, and the most distinguished artists will be invited to participate, but nothing which has already been exhibited in Italy will be accepted. The works of artists not personally invited will be submitted to the decision of a jury of admission composed of five members. Except in the cases of collections of certain celebrated artists, either living or dead, and in other special circumstances, no artist will be allowed to send more than two exhibits of the same class. Gold medals will be awarded to the best artistic and decorative works. Intending exhibitors must give notice in a duplicate form not later than January 1st, 1907. Applications for forms, and all subsequent communications, must be made to the following address—"Segretario, Esposizione Artistica Municipal, Venice, Italy." The exhibits must reach the exhibition building not later than March 25th, 1907. Ample facilities will be granted to foreign artists. Mr. Zuccato says that this Exhibition has so far proved a great success, and has been very useful in the promotion of all branches of art. Great credit is due to the municipality for carrying on, every two years, such a difficult enterprise, with a view to improving the artistic taste of the public in their everyday life. The decorations and fitting up of the Exhibition will be undertaken by the best modern artistic house decorators, always provided the decorations are made to harmonise with the other works of art exhibited in the different rooms. Italian and foreign manufacturers will enjoy equal rights as do the artists.

Northern Territories of the Gold Coast.—The acting Governor is able to report (Cd. 2684) that "travelling in the Northern Territories is, with the exception of two small districts, as safe as in any civilised country." The policy of supporting and emphasising the position of the paramount native chiefs, while, at the same time, making them realise their responsibility, appears to be the only practicable system of administering the country, which has an area of 24,000 square miles, a population estimated at 2,500,000, and an available staff of some eighteen British officers, who are called upon to perform both civil and military duties. There are, however, two exceptions to the general tranquility—the centre of the Lobi-Daganti country, and a tract of country known as the Nalrizo Hills, lying a day's journey to the north-west of Gambaga. The people of these districts "loot caravans with impunity, continually fight amongst themselves, and are a constant source of terror to the surrounding friendly tribes, whose markets they absolutely ruin." In the rest of the colony the Chief Commissioner reports to the Governor that there is a growing desire among the people to develop trade, and form new trade routes and markets, the people realising that truculent and insubordinate districts are avoided by merchants. In the opinion of the Commissioner, "the recent widespread movement of Mohammedanism has done much to bring this state of things about, and though viewed with some alarm at first, enquiries and personal observations lead to the conclusion that it has done more to bring about order, decency, and a local cleanliness, than years of our administration have effected."

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

HERALDRY IN RELATION TO THE APPLIED ARTS.

By George W. Eve.

Lecture III.—Delivered May 28th, 1906.

The heraldic group of armorials is called an achievement, hence hatchment, the lozenge-shaped panel that is sometimes placed on the front of a house of mourning. An achievement consists principally of shield, and crest, with the helmet and mantling, but in addition mottoes, coronets, supporters, and other accessories may form part of it. The proportion of its parts varies very considerably. During the Middle Ages it was something like 2-5ths of the whole height for the shield, and 3-5ths for the helm and crest, but these proportions were much modified by circumstances. In some cases, as in the monument to Lord Bourchier in Westminster Abbey, to which I have before referred, the shield was very small indeed; because the arms were adequately displayed elsewhere on the monument, while the crest was not. The armorial group on the keystone of the arch of Henry V's chantry, also in Westminster Abbey, is similar in this respect. The general proportion that I have indicated, is a very satisfactory one, however, which brings the helm a little above the centre of the composition, in which it serves as a point on which the other objects group themselves. This proportion also affords scope for clear definition of both arms and crest, and has a satisfactory and dignified appearance. The whole design of an achievement should, of course, be directed to the most distinctive display of all the armorials, and their relative importance will in some measure dictate the proportion. Thus if a shield be quarterly, or otherwise complicated, it may be enlarged, and will still look right because the reason explains itself.

Whatever the style of the design, it should express its subject in the most explicit way, not allowing scrolls to outshine the crest nor badly composed mantling distract attention from the arms.

The general method of grouping armorials may have been suggested by their actual relative position (as may be seen in the equestrian seals) as well as by the custom of carrying armorial insignia in procession, when they were borne suspended from staves, or in stationary ceremonials were hung from stakes or small trees.

There is nothing of special heraldic significance in any particular grouping of the shield with other objects; and the shield and the crest may be placed side by side, or in any other way that suits the general design. Shields and crested helms may alternate in a frieze or a string course, for example, and in such a case the mantling may be found useful as running ornament with which to tie up the whole design. And similarly, in circumstances which make undesirable the piling up of the components of an achievement, they may be placed side by side with complete propriety.

The principle of concentration on the most significant part of the heraldry is nowhere more habitually violated than in the treatment of Supporters, for they are often designed with little regard for the armorials that they support. Their privileged character, as accessories to the arms of peers and of other persons of exceptional distinction, has resulted in their treatment in a way that is by no means in accord with their relative importance. Originally derived from badges (of which I shall have something to say presently), their evolution from that state to their present

condition is well illustrated in the seals, which it soon became customary to ornament by filling with decoration the spaces between the triangular shield and the surrounding circle. And this was done in various ways—at first with scroll ornament, then with badges, which, from being small and as it were accidental

FIG. 22.

devices, increased in regularity and importance until they acquired a recognised status as supporters, and in later times have been allowed to dominate the whole group, which development has been assisted by the natural readiness of sculptors and others to make the most of an inviting subject, but the result has been to belittle the more important shield. It is very necessary to bear in mind that the perfect legibility of the arms on the shield is

FIG. 23.

the essential point, and that the whole achievement should be designed accordingly.

Fig. 22 the seal of John de Segrave, one of the signatories to the Barons letter to the Pope in 1300, show the badges beside the shield; Fig. 23 the seal of Anne Courtenay, Countess of Devon, has animals similarly disposed, but with their backs to the shield; in Fig. 24, the seal of Ralph Neville, Earl of Westmorland, the greyhounds though very subordinate, have assumed the usual pose and direction of

FIG. 24.

supporters; and in Fig. 25, the beautiful seal of Edmond Beaufort, Duke of Somerset, the supporters appear in their full development in proportion.

Supporters still retain a greater amount of freedom than other heraldic objects in regard

FIG. 25.

to pose, which in their case is by no means so rigidly prescribed. Thus, although an animal is usually in a rampant position, it is not necessarily so, and is not so described in the blazon. A lion, for instance, is not blazoned a lion rampant or otherwise, but simply a

lion ; so that if the occupied space renders another pose desirable it may be adopted, though at the same time there can be no doubt that the rampant position is best whenever possible. Thus, in horizontal positions, such as friezes, a shield may have couchant supporters, and when an animal supports a banner it may be sejant, that is, sitting. Again, the supporters need not be placed exactly at the sides of the shield if there is any reason, with regard to design, for another position. In the seals they often occupy spaces a little above the shield, and sometimes seem to hold up the helm and crest or the coronet. In other cases they are below the shield, really seeming to hold it up, as in the windows at Ockwells, that beautiful series of armorial glass which contains the arms of Henry VI. and of his queen, Margaret of Anjou, supported by heraldic antelopes, the king's device, and by her own eagle. It will, of course, be noticed that the perpendicular form of the window space suggests this treatment. Apart from such controlling reasons, the places at the sides of the shield are without doubt most satisfactory.

Remembering that the shield is the principal point, the supporters should be composed with due regard to it, and their lines should lead into and emphasize it as the central motive. An effective amount of symmetry should also be established between the respective figures when it is possible, and the main composition lines of supporters will need special emphasis when animals have their heads turned away from the shield in the position of guardant (and still more so when they are regardant), in order to counteract the dispersing effect of those poses. Here it must be noted that freedom of pose in supporters does not extend to the head, for when a supporter is blazoned guardant it must be full faced, or nearly so, and when regardant must look backwards.

Actual physical support need not be insisted upon, so that there is still less obligation to over insist on it. As we have seen, birds as well as beasts are used as supporters, and an interesting instance of fish supporters occurs on the seal of Dauphiny ; and another case is that of the City of Glasgow.

Besides the actually heraldic supporters, other figures are used in a similar way, but in a purely decorative manner, such as Angels and Amorini. Of these there are, of course, numberless examples, among them the groups of angels which hold the shields on the spandrils of Henry 5th Chantry in Westminster Abbey, and the demi-angels with badges arranged in Henry VII.'s Chapel and other parts of the Abbey, which latter, by the way, were closely followed by Pugin in the decoration of the Houses of Parliament.

Interesting examples of angelic supporters occur in the tapestry at Hampton Court Palace. They contain the arms of Cardinal Wolsey and those of the Archiepiscopal See of York impaling the insignia of a archbishop, each shield being supported by kneeling angels. The arms of the great Cardinal were sometimes supported by griffins or again with amorini. A beautiful instance of the latter occurs in the panel, in high relief, which faces the Crown Court at Hampton Court.

A word of caution regarding such non-heraldic figures may be useful in order to avoid possible misunderstanding, namely, that their purely ornamental character should not be confused by the addition of details or drapery that might have heraldic significance, such for example, as the angels clothed in tabards of the royal arms of France which formerly supported the French shield.

Among other insignia that may accompany armorials, Crowns and Coronets are of conspicuous importance, and present excellent opportunities for decorative treatment. In their origin, they were simply circlets of dignity, which however, soon took regular form and symbolic significance.

The King's crown is composed of four crosses and an equal number of fleurs-de-lis, raised alternately on the rim ; and has two arches which rise from the crosses and support at the top an orb which also terminates in a cross. These, which are the essential parts of the crown, may be treated ornamentally, with great freedom. Tudor architecture is especially rich in examples of great variety and beauty, and of these some of the best are in King's College Chapel, Cambridge, and on St. George's Chapel at Windsor. There is a series on the exterior wall of the latter chapel, of which no two are alike in detail, though, of course, they are all essentially the same. However varied the treatment may otherwise be, the arches always rise from behind the crosses, never from the fleurs-de-lis in the case of the English crown. Though in the Scottish one they do so in some instances.

It must be understood that the King's crown is an Imperial Crown, and has for centuries been so held to be, certainly since the time of Queen Elizabeth. Indeed it is quite probable that there was some such intention when it was first

enarched by Henry V. However that may be, there is no distinction in our heraldry between a Royal Crown and an Imperial one, and when crowns occur as charges they are invariably described as "Imperial Crowns."

The shape of the arches has varied very much from time to time and even at the same period, for it has never been thought necessary in decorative design to follow the exact pattern of the actual crown. This has remained constant since the time of Charles II. The Tudor crowns were in general, either pointed like a Gothic arch; or flat at the top, as are those at Windsor and Cambridge. The latter form gives a squarish line that is suggestive of strength, but it unfortunately led in later times to a less satisfactory shape, that of the

The coronets of peers, which had taken definite form for various ranks in the seventeenth century, were officially regularised by Charles II., and their various forms can be seen in any peerage.

About the caps which they enclose there is sometimes a little question, however, but there is no doubt that the coronet itself is the essential emblem of rank, and that the cap may be omitted if necessary. Indeed, it was so admitted, and in official work, soon after the definite rules for the wearing of coronets were made. Of course, if one is painting a portrait of a peer in his Coronation robes, his coronet will be represented with a crimson velvet cap lined and turned up with ermine, but in ornamental design it is non-essential.

Fig. 26.

Georgian crown, in which the arches were much depressed at their intersection. The present shape, as approved for official use, is a return to the more beautiful pointed arch.

The decoration of the arches may take many forms—large pearls, architectural crockets, or oak leaves, and so forth. With regard to the treatment of the crosses on the rim and on the orb at top, there is an unfortunate tendency to spread the ends of the limbs until they almost touch at the corners, and the result is to suggest the form of a square that is perforated saltirewise with radiating vesica-shaped holes, and not that of a cross at all. The earlier, more open form is much more beautiful.

As to the jewels, it is well to show them as *en cabochon* rather than as cut into facets; and it is to be understood that their arrangement and colour is quite conventional and need follow in no way the details of the actual crown. The same remarks apply equally to the coronet of the Prince of Wales, which, however, has but one arch.

It should be noted that peer's coronets must not be jewelled, and that the so-called pearls that are on those of all ranks below dukes are really silver balls, and must so be represented. Jewel forms are indicated on the circlets of all above the rank of a baron in engraved or other metallic surface decoration, in place of actual jewels. The rim of a baron's coronet is plain, with the exception of a slight decorative line that may run round it.

I have before pointed out how boldly and decoratively crowns and coronets were treated in relation to the shield down to the sixteenth century, extending at least from side to side of it, and sometimes beyond as though enclosing its top, and this point is illustrated effectively on the tomb of the Countess of Richmond, mother of Henry VII., in Westminster Abbey. Comparison is impossible between the strong, dignified treatment of this beautiful monument and the small and mean way in which the thing is done in most modern work.

A series of coins and seals is very instructive in this way. Thus, the golden bulla, probably designed by Holbein, with which Henry VIII. sealed the treaty of the Field of the Cloth of Gold has the crown treated expansively in the way that I have described, from side to side of the shield (Fig. 26). Turning from that to modern coinage, we see the crown more suggestive of the top of a pepper-box. There is improvement in this respect, but there is still evident a fear to make the crown of full decorative proportion.

Badges and Devices, forms of personal allusion from which heraldry sprang and to which it has returned now and again with renewed interest, are among the objects that are most useful in heraldic decoration because of the freedom with which they can be handled. Like mottoes, they are outside the restrictions of heraldic rule, and may be invented, and applied or disused, with perfect facility. Historic badges without number are to be seen in architectural decoration where they usually occur with splendid effect. Many badges allude to events, as does the sword chape of Lord Delawarr, whose ancestor took prisoner the French King ,or the purses which commemorate the Lord Treasurer-ship of Lord Cromwell, on the mantelpieces of Tattershall Castle ; but the majority, especially such as were devised in large numbers in the fifteenth century, are full of a more purely symbolic meaning. Thus, the porcupine of Louis XII. was an emblem of offence as well as defence however, for it was believed to be able to shoot its quills and so attack at a distance. The lithe little ermine of Anne of Brittany was emblematic of unsullied purity, as well as allusive to the conventional ermine shield that was her coat of arms. A beautiful representation of a badge of clasped hands is sculptured on a marble frieze that is attributed to Matteo Civitali, of Lucca, in the fifteenth century, and is shown in the slide.

At Westminster Abbey may be seen the splendid bronze gates, with the badges of Henry VII. and his queen, Elizabeth, and of his mother, Margaret, Countess of Richmond, which close his mortuary chapel.

The Royal Badges of the present time are regulated by warrant ; among them the rose, thistle, and shamrock, both singly and joined together on one stem in the Union badge ; also the red dragon and the harp.

The distinctive ostrich feather plume badge of the Prince of Wales consists, I need hardly say, of three feathers ensigned with the Prince's coronet, of necessity without the arch, and having below two scrolls of garter blue, bearing the motto, "Ich Dien," in gold letters. These are the heraldic facts, but the artistic interpretation may vary very much ; whether the badge be treated in the early and more severe style, or in the freer curves of renaissance work, it is always a very decorative and interesting object. Its origin is obscure, but a feather was a favourite royal badge from early times, and its symbolism is said to be that of steadfastness ; for, however bent it may be, it returns to its original form. Edward the Black Prince directed that his ostrich-feather badge should attend his funeral, and so it appears on his tomb. At this time the badge was a single feather with its quill enfiled with, that is to say piercing, a scroll. In this form it is thrice repeated, two and one, on the shields which alternate with the Prince's regular armorials. He described the shield bearing the three (separate) feathers as his "Arms for Peace," and that indeed seems to be the character of most badges (though there were others), and it is a character that is very much in harmony with modern feeling, and therefore very appropriate to a motive for present decorative use. The Prince's badge in its present form was not used until the middle of the sixteenth century, and since then has remained unchanged. Its free spreading treatment was perhaps suggested, at a time when Italian influence was strong, by the Medici badge of three feathers interlacing the familiar gem ring of that family's device.

The more recent and approved fashion is to draw the feathers stiffly upright, after the manner of the single feathers of mediæval times ; but though the treatment is, perhaps, preferable to that of the renaissance in some respects, it has hardly the full convincing rightness of mediæval style. One feels that if it had been done in the fourteenth century, the symbolism would have been expressed in a somewhat freer manner and still without loss of strength.

Quite recently, a more distinctively Welsh badge, the red dragon of Cadwallader, of King Arthur, and of Henry VII. has been assigned to the Prince of Wales in addition to the feather badge. This, being also one of the King's badges, is differenced for the Prince, with a label of three points, as are His Royal Highness's other armorials.

As I explained when dealing with crests, badges may be made out of the details of a coat of arms, or the crest itself may be used as

a badge by the omission of the helm and torse, where, for any reason, it is not desired to use the actual armorials; or the badges may even be used in conjunction with them.

Insignia of Knighthood, the badges and Collars of the various orders are other objects of significant importance that present ample opportunities for artistic treatment. The execution of the actual things in goldsmith's work and enamel would afford especially interesting occasion for applying taste and skill to objects that have become commonplace by careless repetition.

It will be understood that, like other heraldic insignia, those of orders must be accurately rendered with regard to the character and sequence of their components, but at the same time there is no obligation to follow a particular style.

The Garter which surrounds the royal arms and those of the Knights of the order is the best known, as it is also the most distinguished of such emblems. It is of dark blue, though it was once light blue, and bears the motto of the order in gold letters. The buckle and other ornaments are gold, and it is now edged with the same, the edging having been first done (purely decoratively) about the middle of the sixteenth century and the lettering may be in any character that seems fit. The collar of the order, from which depends "the George," may be added, to encircle the shield outside the garter, but usually the latter suffices. There being but one rank in this order, one emblem is sufficiently explicit, whereas in orders that are composed of various grades, the manner of placing the insignia in relation to the arms has heraldic significance of specific rank. Thus a Companion of such an order signifies the fact by suspending his badge below his shield. A Knight Commander does the same, and in addition surrounds his arms with the motto circlet of his order, while a Knight Grand Cross further adds the collar outside the circlet.

Although the number of pieces comprising a collar is definite, as for instance in the garter collar (comprised of twenty-six garters in allusion to the sovereign and twenty-five knights companions of the order), it is not necessary to observe this in a design. Usually a smaller number, but of larger size, is employed. The reverse of the gold bulla of Henry VIII., already referred to, is an excellent example, that has been followed to some extent in modern coins. It is also worth remembering that such insignia may be used independently of shields and in a variety of decorative ways.

The Banner, which is one of the few survivors from the many-shaped flags and pennons that flew in battle and tournament, next demands consideration.

It was always rectangular in shape, and was at first high and narrow, not unlike the shields in its proportions, and also, like them, it bore the arms over its whole surface, as it still does. In course of time the shape changed, becoming first square and then longer in the fly than in height, and such proportion is distinctly unfortunate in the case of the Royal Standard or any other banner containing bearings that were, at their making, designed for an upright space, and, nevertheless, have to be accommodated to a wide one.

For convenience in making flags, an official pattern naturally exists, in order to secure uniformity, but the measurements that are given are not heraldically essential. I mention this because it is sometimes thought that as the Admiralty pattern is twice the height for the length, flags and banners for use on land should be similarly proportioned, but that is not so.

It should be noted that the Arms on banners are spaced exactly as they would be on a square shield and always as though the staff were the dexter side of the shield to which all things turn.

Embroidery, of course, entered into the making of elaborate banners, and they were even adorned with jewels. They were usually executed in cut work, that is to say, *appliqué*, which lent itself to the expression of heraldic character with great decorative effect. As a means of expressing heraldry, embroidery is, without doubt, a subject of exceptional interest and beauty, but time will not permit me to deal with it more fully on this occasion.

The Union Jack and the explanation of its essential construction require no special preface, and we will therefore proceed with the aid of Fig. 27, to consider its evolution.

Taking the diagrams in order, first we have two of the three national emblems (1), (2), the cross of St. George and the saltire of St. Andrew, as they had long been used by England and Scotland respectively. Soon after King James succeeded to the English Crown a banner was made (3) which combined the two by placing the red cross of St. George (with a narrow line taken from its white field left round it) over that of St. Andrew, and thence was formed the first Union

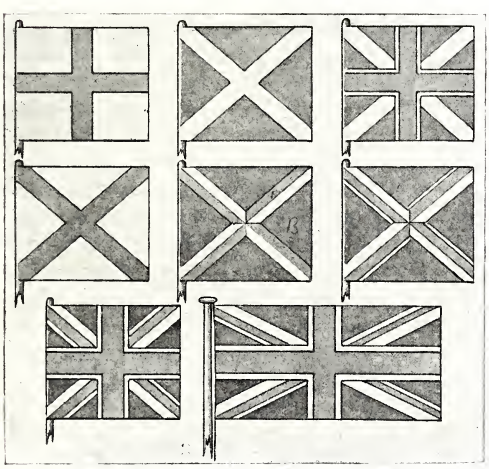
Jack, under which the great naval actions of the eighteenth century were fought.

On the Union with Ireland, in 1801, a fresh element, a red saltire on a white field for St. Patrick (4), was introduced. The red of St. Patrick and the white of St. Andrew were united in equal proportions in this manner: — (5) the red being made to retain a little of its white field as St. George had done formerly, and this was the result so far:—(6). The cross of St. George, with its white edge, was then placed over all, and the final issue is the Union Jack as we know it. This will be found quite easy to do if care is taken to remember the construction, and that the lines from corner

Fig. 27.

(1) (2) (3)

(4) (6)



(7) (8)

to corner of the flag divide equally the broad white and the red of the saltires. Also that in the upper quarter, next the staff, the broad white is uppermost, and for this reason: it is heraldically usual to begin a counterchange of two tinctures, a metal (silver or white) and a colour (red), by naming the metal first. Further, the tincture that is mentioned first is always placed next above the line of diagonal division. Therefore, as the blazon in the warrant is a "saltire per saltire quarterly argent and gules," the white must be where it is. And so any possible question of precedence was automatically avoided.

The form of the flag as shown on the Royal Warrant of 1801 is seen in (7), and is that which has been followed in regimental colours. In this it will be observed that in consequence of the narrow white of the saltire being a fimbriation that is added to the red its outline does not register across. The Admiralty pattern, however, in what one cannot but feel was an unnecessary effort to avoid this, seems to place narrow red strips on top of the white saltire, so that the outside diagonal lines manage to register, but the result is to reduce St. Patrick's half of the joint saltire by the width of the narrow white.

Now, the evident intention in devising the flag was to effect equal representation of Scotland and Ireland in order to lessen the probability of quarrels such as had occurred between the Scotch and English seamen before the first Union Jack was made in the early seventeenth century; and this is perfectly effected by the pattern of the Royal Warrant.

The intention of equality is also evidenced in the warrant by the similar care in designing the Union badge of rose, thistle, and shamrock, for after the badge has been described as a rose with a thistle on one side and a trefoil on the other, the description is carefully repeated, but with the positions of the shamrock and thistle reversed; the obvious intention being to remove any ground for a claim to priority that might have arisen by assigning the dexter side to one emblem in preference to the other. Indeed I have known exception to be taken to a perfectly correct rendering of this Union Badge, under the impression that such precedence did in fact exist.

In applying to individual work the suggestions that have been made, it must be remembered that each material and method has its own technique with which to express the general principles of heraldic design. Each may give suggestions to the other, as sculpture did to painting, illumination to embroidery, and each mode of engraving to the other methods (to name a few of the acting and re-acting influences in the arts); but in so doing it must assimilate the suggestion instead of merely copying the example, so that, finally, the subject is wholly expressed in terms of its own material and method. This is, of course, a fundamental principle of all design, but it is perhaps more often violated in heraldic art than in any other, and it is of no use to go on talking of material governing design, as it always did in good work, if we ignore the teaching in practice. Here it may be well to point out that there is a great and evident danger that the appreciation of some particular style of work, may cause that style to be habitually followed,

until it becomes a mannerism; and, following the usual process of decadence, loses the important qualities of characterisation, expression and vigour, in the mere repetition of a quaint form.

On the other hand we shall do well, I think, to set aside any excessive striving after mere originality of form, and rather endeavour to embody in our work the qualities that we recognise in good examples in the most direct, vigorous and beautiful way we can, and individuality will inevitably assert itself if there is any to come out.

In old times the most satisfactory and beautiful works were the product of individual intelligence working under a sound commonsense tradition, and though we have not the advantage of continued tradition, we may do much by careful study of the old and excellent examples that are at our disposal; and it is certain that a clear understanding of the subject itself and especially of the qualities that should be striven for in its expression as design will make for a good result. Also, improvement in intention will result in better work, without too violent a change in style, or that transition from one groove into another to which excessive worship of special styles seems to lead. This may be valuable in a number of ways and especially in designing heraldry that is to accompany other decoration, or which has to comply with other forms of inevitable dictation.

FOREIGN LABOUR STATISTICS AND INDUSTRIAL ORGANISATIONS.*

Conciliation and Arbitration.—As distinguished from the voluntary boards of conciliation and arbitration established in various parts of the United Kingdom, conciliation and arbitration boards on the continent of Europe are official in character. In Germany, for example, industrial courts, must, according to law, be formed in all towns of over 20,000 inhabitants, while elsewhere they may be formed at the option of the Government or on the requisition of a sufficient number of employers or workpeople. The members of the industrial court are elected in equal numbers by employers and *employés* voting in separate bodies. These courts discharge several minor functions, such as the settlements of individual claims arising out of labour contracts when the amount in dispute does not exceed £5. Their prime function is as formal boards of conciliation and arbitration in the case of actual or intending strikes or lock-outs. When acting in this capacity, which it may do on the application of either of the disputing parties or on its own initiative, it must consist of a president and four or more representatives of the employers and of the workpeople in equal numbers, these being in no way concerned in the dispute at issue. When only one side applies the court endeavours to persuade the other to make application. If a conciliation is effected the agreement is signed by the Board and by representatives of the parties, and is published. In the event of failure, the Board embodies its conclusions as to the terms upon which it considers the parties ought to agree, and calls upon the disputants to declare their acceptance or rejection of the award within a certain time. In any case the decision of the court is published. By the end of 1905, 411 industrial courts had been established in Germany. During five years 51 per cent. of the disputes referred to such courts were settled by them, the extremes being a maximum of 86 per cent. in 1905, and a minimum of 27 per cent. in 1902.

In France, considerable initiatory powers are vested in the local magistrate, who may nominate conciliation disputes at his own discretion, or on the petition of either of the disputing parties. Where attempts at conciliation fail, the magistrate invites the disputants to accept arbitration, to which end each side nominates an arbitrator, or one is chosen jointly. If the first arbitrators cannot agree others may be called in. There is no compulsion at any stage of the proceedings, but applications to set the law in motion, refusals to assent, reports of conciliation committees, and decisions of arbitrators must be made public. The cost of procedure falls either on the communes or on the departments. In a considerable percentage of cases the offer of mediation is refused (34 per cent. of the total for 1904-5) for the most part by employers; where, however, conciliation committees are formed by consent of both sides, a successful issue appears to be reached in a large proportion of cases (over 60 per cent. of the cases actually referred to them in 1901-5).

In Belgium, the functions of conciliation and arbitration are exercised through local councils of conciliation and labour which are established by Government on the request of the communal councils. Each council is divided into sections according to the number of local industries of sufficient importance. The members of the section committees are elected in equal numbers by the employers and by the workpeople, the committee choosing its own president and secretary. The cost of the proceedings is borne by the communes.

In Holland, the chambers of labour are the official boards of conciliation, these being composed of representatives of employers and workpeople in equal numbers. Their objects are to collect information on questions affecting labour, to advise Government departments and local authorities on labour questions, and to prevent or adjust labour disputes, referring such disputes to arbitration if necessary. Between 1899 and 1904, there were 32 cases of successful and 24 cases of unsuccessful intervention, by chambers of labour. In nine further cases offers of intervention

* Compiled from the third abstract of Foreign Labour Statistics (Cd. 3120), see *ante* p. 981.

by the chambers were declined, seven times by both employers and workpeople, and twice by employers only. Besides acting as conciliation boards, the chambers of labour are engaged in settling differences as to terms of employment, in negotiating general agreements for entire trades, and in furnishing advice or information at the request of either employers or workpeople. In 1899, the councils of labour took part in 13 cases of negotiations concerning terms of employment; in 1893, the number had increased to 73, the total number of such cases, during the five years (1899-1903) being 242.

In Italy, courts of Probi Viri are established by royal decree for given districts, the members being chosen in equal number by the employers and workpeople voting in separate bodies, the president being appointed by the Government. A court has separate sections for conciliation and arbitration. Where conciliation fails, the case goes forward to the arbitration court, where, in the event of its jurisdiction being accepted by both parties, a binding decision is given. Only a few courts have been formed, and their interventions have not been numerous, though such interventions have been, almost without exception, successful.

In the United States industrial conciliation is wholly a matter regulated by State law, save for such inter-state undertakings as railways. The machinery of conciliation and arbitration which has been created by the special laws of the different States falls under four categories :—

(1) Local arbitration without standing tribunals ;

(2) Standing district or county boards, elected by employers and workpeople ;

(3) Conciliation and arbitration by the mediation of the State Commissioner of Labour; and

(4) Central State Boards or Commissions.

In conciliation of the first-class a local judge or justice of the peace appoints a committee of two or four persons with himself as president to adjudicate upon the evidence tendered, the costs being borne by the parties equally. Tribunals of the second-class are appointed for a year by the local civil court on the petition of either employers or workpeople, or both together, the two sides having equal representation and choosing an umpire jointly. Only three States use the third method, others having discarded the same ; this official is required, on the petition of either employers or workpeople concerned in the dispute, to proceed at once to the place and "diligently to mediate" between the contending parties. Should his personal mediation be unsuccessful, he must endeavour to induce the parties to accept arbitration, and on refusal to obtain a statement from the refusing party, giving reason, which statement must be made public.

Conciliation and arbitration by the State Boards is now the commonest method of settling industrial disputes in the United States, being in use in seventeen States. As a rule, such a Board consists of three members, the term of election varying from one to four years. Its functions are (*a*) mediation and conciliation in the case of strikes and lock-outs ; (*b*) arbitration ; and (*c*) investigation for the purpose of publishing a report as to the cause of a dispute and the responsibility for it. In certain States, the mayors, judges, or other public officials, are required to notify the Central Conciliation Board directly they hear of industrial disagreements, but it is the duty of the Board to intervene independently of formal notification. The number of successful interventions is considerable, the returns for the three years ending 1904 were 36·5 per cent. in New York, and 67 per cent. in Massachusetts.

Accident Insurance.—The principle of compulsory insurance has been applied in Germany, Austria, Hungary, France, Italy, Belgium, and in some of the smaller European countries. Its scope varies in different countries ; for instance in France it applies only to seamen, in Denmark to fishermen and seamen, in Belgium to miners, and in Hungary to agricultural labourers. In Germany, on the other hand, besides industrial employments the law comprises seafaring and agriculture. Within the various insurable occupations, the obligation is as a rule confined to persons whose earnings fall below a fixed sum. In Germany all persons earning more than £150 per annum are exempt; in Italy the limit for exemption is £85, in Norway £60, and in Finland £30. On the other hand, in Austria and in Holland no limit is fixed.

The following interesting notes contrast the most important of compulsory insurance in Germany and Austria-Hungary, where such insurance has been in operation for the longest time. The laws in the two countries differ, not only as regards the range of occupations covered, but also in respect to (1) what constitutes an "accident" for purposes of compensation; (2) the proportions in which the burdens have to be borne by employers and workpeople respectively; (3) the manner in which the funds are raised ; and (4) the scale of compensation payable to the various classes or persons whose means of subsistance are impaired as a result of the accident.

In Austria the only kind of accident excluded from compensation is one which the workman has intentionally brought about ; in Germany the same rule held good until the revision of the law in 1900, when all accidents which are due to the gross misconduct of the workman were also excluded from the area of compensation. In the earlier period of disablement the cost of compensation is borne by the sickness insurance funds, to which, both in Germany and in Austria, the workers contribute two thirds and the employers one-third. But as regards the length of this earlier period, the laws of the two countries differ. In Germany, it extends to thirteen weeks, while in Austria it is limited to four. In Germany, however, the money spent in compensation after the thirteenth week is paid in its entirety by the employers, while in Austria the employers are entitled to deduct 10 per cent. of their contributions from the workman's

wages. In both countries, the funds are raised and administered by associations of employers, formed expressly for that purpose, but while in Germany those associations are organised by trades, in Austria the basis of organisation is territorial. Thus, for purposes of accident insurance, Germany has sixty-six industrial and forty-eight agricultural associations, while Austria has only seven territorial associations, each of which comprises every insurable employer within a particular area, irrespective of the branch of industry in which he may be engaged. In both countries the amount of each individual employer's contribution towards the expenses incurred by his association in respect of accident indemnities is fixed by the executive of the association, and depends upon the degree of accident risk inherent to his trade (as determined by a table of risks prepared by the association) and the amount of his wages bill.

The scales of compensation payable in respect of accidents in the two countries are as follows:—For total disablement the pension payable under the German law represents two-thirds of the injured person's earnings, but in the event of that person being at the same time entirely dependent on strangers for attendance and nursing, the full amount of such earnings is given, up to a sum of £75, and if the actual earnings are in excess of that amount, one-third of such excess is also given. The pension allowed for total disablement under the Austrian law amounts to 60 per cent. of the annual earnings, and can in no case exceed £60. For partial disablement the laws of both countries allow pensions, the amount of which depends on the extent to which the injured person's earning power has been impaired by the accident. In the case of fatal accidents the laws of both countries provide for the payment of burial money and of pensions to surviving dependants. In Germany the burial money represents one-fifteenth of a year's earnings, but not less than £2 10s.; in Austria the burial money must not be less than £2 2s. In Germany the pensions to surviving dependents may amount in the aggregate to 60 per cent. of the earnings of the deceased; in Austria to 50 per cent.

Some statistics trace the growth of such insurance in the two countries since 1890. From these it may be noted that in Germany the numbers insured were in 1694 13,619,750 persons, and that in that year the sum of £1,015,765 was spent on compensation. In 1903 the numbers were 19,465,422, and the expenditure £5,895,645. The increase in cost is quite out of proportion to the numbers insured. Thus in 1892, £1,617,010 was spent when 18,014,280 persons came within the scope of the Acts. An increase in 12 years of 8 per cent. in numbers has been accompanied by an increase of 350 per cent. in expenditure.

In Austria, excluding the mining industry, 1,231,818 persons were insured in 1890, the expenditure then being only £17,133. In 1903 the numbers insured (the mining industry again excluded) were £2,621,929. The same tendency to an increase in cost of proportion to the increase in the numbers insured is also manifest in the case of Austria. Taking the last seven years only the increase in the numbers affected has been 30 per cent., while the increase in cost has been 240 per cent.

Sickness Insurance.—A feature in German social administration which particularly impressed the present reviewer during fifteen months spent in Berlin, was the manner in which compulsory insurance against sickness enabled tuberculosis to be combatted in a very systematic manner. The consumptive patient is almost invariably treated in the early stages of his complaint by one to six months at certain sanatoria, during which time the domestic financial anxieties which might act as a preventive upon his undergoing the necessary treatment are alleviated by the payment to his family of half his wages. The law renders it obligatory upon work-people (excluding seamen and fishermen), clerks and small employers to insure against sickness. The benefits secured are medical attendance and medicine during illness, with surgical appliances and hospital treatment if necessary, and sick pay from the third day of illness at half rates. These benefits may continne for twenty-six weeks, after which time the liability is transferred to the Accident Insurance Fund in cases where the sickness has resulted from accident. In Austria, medical attendance, &c., is as set forth above, the sick pay amounting to 60 per cent. of the standard daily wages and continuing for twenty weeks. Funeral benefit is accorded in both countries. In Germany, two-thirds of the contributions are provided by the *employé*, and one-third by the employer, the workman's share varying from $1\frac{1}{2}$ to 4 per cent. of the daily wages. In Austria the proportions are the same, save for the proviso that the contributions of the latter may not exceed 3 per cent. of their wages. A statistical table gives the number of workpeople insured and the total expenditure in connection with sick allowances for Germany, Austria, and Hungary.

In Germany the numbers insured have increased from 7,282,609 in 1894 to 10,224,297 in 1903, the expenditure having increased from £5,576,610 in 1894 to £10,261,192 in 1903. In Austria the increase has been in numbers from 1,870,942 in 1894 to 2,489,061 in 1903, the payments being respectively £1,205,287 and £2,147,970.

Old Age and Infirmity Insurance.—This is secured in Germany by contributions from all working-class wage earners, including domestic servants. An infirmity pension is conditional upon inability to earn one-third of the wages of an able-bodied workman, and an old age pension upon the completion of the 70th year. The premiums are paid every week by employers and workpeople in equal sums. At the end of 1904 the value of the sums invested on this account was £58,233,292 and the sum paid in pensions of both kinds in that year £6,442,455. The amount of premiums paid was £7,704,390. The average value of an old age pension was £7 17s. 2d., and of an infirmity pension £7 15s. 2d.

INDUSTRIAL ALCOHOL IN GERMANY AND FRANCE.

In Germany in 1905, there were over eight million acres planted in potatoes, from which were produced over forty-eight million tons or an average of two hundred and seventeen bushels to the acre. With the exception of the year 1901, which was specially favourable for the cultivation of potatoes, this crop exceeds all previous years. The most important ways in which the potato is utilised in Germany are for human food, for fodder for animals, also in the industrial arts, for the distillation of alcohol, and for the manufacture of starch, starch products, such as starch sugar, starch syrup, dextrin, &c. The best kinds are used for eating, the next best for fodder, and the inferior descriptions for the distillation of alcohol. There are no statistics available, which would indicate the consumption of the potato for purposes of human food, but it may be safely estimated at 50 per cent. of the total production. For many years, the use of potatoes for technical manufacturing purposes has been a popular means in Germany of disposing of a portion of the crop. The most important ingredient —starch—is used either for manufacturing pure starch, or for transformation into alcohol by means of fermentation after previous saccharification, and then by distillation to separate the alcohol from the other substances. The by-products of factories working with potatoes furnish large quantities of nutritious fodder, which is highly appreciated in Germany, where the prices of animal food are high.

In the campaign year, 1904-5, there were over 91 million bushels of potatoes consumed in the production of 63 million gallons of alcohol; there were 72,172 alcohol distilleries in operation, of which 6,048 farm distilleries and 21 industrial distilleries used potatoes, 6,620 farm distilleries and 780 industrial distilleries used grain, 39 distilleries used other materials, 29 used molasses, and 57,635 small farm distilleries (called "Materialbrennerein") used fruit, wine, &c. For purposes of taxation, the American Consul-General at Berlin states that German distilleries are divided into three classes—(1) Industrial distilleries ("Gewerbliche Brennereien"), carried on by individuals or companies solely for manufacturing purposes; (2) Agricultural distilleries ("Landwirtschaftliche Brennereien") are those using as raw materials, potatoes or grain grown on the owner's farms, or on the farms of one or more of the owners, if the distillery belongs to a co-operative society or company; (3) Material distilleries ("Materialbrennereien") are those using berries, fruits, wine lees, grape pressings," &c. The alcohol-production of the agricultural distilleries varies from between 110 and 220 gallons of pure alcohol to 66,000 and 88,000 gallons annually. Last year the smaller plants, the material distilleries, mainly situated in the Schwarzwald, in the Grand Duchy of Baden, and in Alsace-Loraine, 57,635 in number, produced together 792,000 gallons of alcohol. In the same year, on the other hand, the 6,069 potato distilleries produced over 63 million gallons. In Germany, the distillation of alcohol from potatoes is one of the most important branches of agriculture. It alone, in some cases, renders farming pursuits possible in regions situated at a distance from business centres, and possessing light soils, and many farms owe their existence to their distilleries.

It is impossible to obtain satisfactory data relating to the cost of production of alcohol from the different materials. It depends upon different conditions, the size of the distillery, the efficiency of the apparatus, and the methods used, &c. In 1904-5 there were 44 million gallons of alcohol used for drinking purposes, 30 millions for consumption in the industries, of which 22 millions were fully de-natured, and 3 millions for the manufacture of vinegar. The consumption for drinking purposes, with the exception of the year 1894-95, was the lowest since 1891-92, while the quantities used for the industries were the highest ever known. The fully denatured alcohol used during 1904-5, was almost exclusively employed in producing power, light and heat. During 1887-88 the amount of de-natured alcohol consumed was only three million gallons, or, in other words, the consumption of alcohol for light, heat, and power purposes in Germany has increased over seven times in the past seventeen years. The use of spirits for driving motors, lighting rooms and public places, cooking food and producing heat, appears to have a great future in Germany. "Incompletely denatured" alcohol was used last year in varying quantities for rubber preparations, the manufacture of celluloid, for making synthetic camphor, for sulphuric ether, for the manufacture of photographic paper, dry plates, electrodes for electric storage batteries, acetic ether, surgical dressings, chloroform, iodoform, ethyl bromide, for making ink, for finishing silk bands, for varnishes and polishes of different kinds, for soap making, and for many other purposes. Much, if not the greater portion of the partially denatured spirit used by German manufacturers is denatured in the works on which it is actually employed, and this is invariably the case when the volume of the spirit handled is large. The distribution of spirit produced in Germany is practically controlled by a society known as the "Centrale für Spiritus Verwerthung," with its principal offices in Berlin. It has written agreements with the principal distillers to take their products at a certain price, determined by the society at the commencement of the campaign, after it has obtained sufficient statistical data concerning the crops. At the end of the year the society adjusts with the distillers the losses or profits based upon the fixed price, resulting from the operations of the society in disposing of the spirit.

The alcohol which is used in France for various industrial purposes is manufactured mainly from beet root, the material being either the refuse molasses from sugar factories, or beets which by reason of unfavourable weather, inferior soil or other causes, only a small proportion—four to six per cent.—of

sugar, potatoes, and grain are also used to some extent for distilling purposes, but to a relatively much less extent than in Germany, where the potato is the great dominating source of industrial alcohol. Unlike the German system, which permits several methods of denaturation according to the special purpose for which the spirit is to be subsequently employed, the French statute provides but one general process which is applied indiscriminately to all alcohol to be employed tax free in manufactures, and for burning or lighting purposes. The statute provides that all alcohol to be denatured shall contain not more than one per cent. of fusel oil, and shall be exactly 90 deg. purity. If of a higher grade the spirit must be reduced; if lower it must be strengthened to 90 deg. before it can be denatured. The total consumption of denatured alcohol varies from $5\frac{1}{2}$ million to $6\frac{1}{2}$ million gallons, and the quantity used does not fluctuate much beyond these limits, although the French Government has endeavoured in various ways to encourage the manufacture and use of spirits for heating power, illuminating and other industrial purposes. The French Government, like that of Germany, was attracted by the idea that if the manufacture and use of denatured alcohol could be sufficiently stimulated and extended, there would be not only added an important product to home agriculture, but the country would be provided in case of war with a native grown fuel for military vehicles and other important purposes, which would not be imperilled by the interruption of an important supply of petroleum products. Accordingly, the Ministers of Commerce and Agriculture organised a special exhibition and offered prizes for the most effective types of alcohol motors, both stationary and portable, for motor vehicles and agricultural machinery, as well as alcohol lamps, stoves, and other articles for domestic use. So far as can be ascertained, the success of this movement has been, on the whole, disappointing, so that, as already stated, the consumption of denatured spirits for such purposes has not increased to any important degree. The motor car builders admitted, as a result of their experiments, that alcohol was, chemically considered, a purer and more economical fuel for France than petroleum, but it required, for highest efficiency, a motor specially constructed for burning alcohol, the vapour of which explodes more suddenly and powerfully than that of petroleum essence. Moreover, the gases generated by the combustion of alcohol vapour attack steel and iron, so that the cylinders and valves proved difficult to keep bright and in order. A mixture of 20 to 30 per cent. of benzine with the alcohol was tried, and showed some advantage, but, according to report, the alcohol and benzine volatilize at different temperatures, so that one ingredient would be exhausted more rapidly than the other, and the experiment fell short of the anticipated success. For the same reason, the alcohol denatured with wood alcohol and benzine proved only partially successful in lamps. Such of these as were tested required half a minute or more to light, and unless burned in a cold room the light diminished gradually to about 50 per cent. of its original brilliancy until extinguished and refilled, so that after a more or less unsatisfactory trial, most of the users or alcohol lamps returned to the use of petroleum or colza oil.

It is not asserted that these unsatisfactory results with denatured spirits were unavoidable, or might not have been averted by improved and more scientific apparatus, but this is substantially what has occurred. There was of course danger that denatured alcohol might be so far purified by skilful chemical treatment as to be applicable to certain forms of manufacture where pure spirit should be employed. To prevent this the law of August 16, 1900, forbids, under penalty of heavy fine and imprisonment from six days to six months, any rectification, or attempted rectification, for any purpose of alcohol which has been denatured, unless done under the supervision of Government officials, and with a special license previously obtained, in which the quantity of spirit to be restored, the degree of such restoration, and the purpose for which it is to be finally employed, are elaborately prescribed and authorised. Manufacturers of ethers, chloroform, and certain other chemical products, are permitted to purchase pure alcohol free of the tax, but the whole process must be carried out under the supervision of revenue officials, and guarantees that the spirit so exempted will not be used for any other purpose. Alcohol is very largely used for the manufacture of smokeess powder, but as that is a Government monopoly, no special license or supervision is required. The last year for which complete statistics are available, covering the manufacture, denaturing, and various uses of alcohol in France, presents the following interesting records, giving the materials from which alcohol was manufactured, and the quantity produced in each case: —Grain and potatoes, 7,744,000 gallons; molasses, 14,740,000; beets, 20,372,000; wine, 572,000; apples and pears, 45,000; lees of wine, 1,210,000, and all other materials, 2,300,000 gallons. The imports of alcohol during the same year amounted to 2,024,000 gallons. Of this total quantity of alcohol manufactured and imported, 29 millions were for drinking and other purposes; 8 millions were denatured; and 2 millions were converted into vinegar. The remainder was exported, consumed free at distilleries, lost by leakage, &c.

JAMAICA.

Sir Alexander Swettenham's report upon Jamaica (Cd. 2684) shows that the island is in anything but a prosperous condition. One of the most beautiful islands within the British Empire, with a soil singularly fertile, a climate that for the tropics is temperate, and near markets for its products, Jamaica does not thrive. The imports per head of the population have fallen from £2 19s. 3d. in the quinquennial period,

1890-1 to 1894-5, to £2 3s. 2d. in the five years ended 1904-5; whilst, taking the same period, the exports fell from £2 14s. 9d. per head to £2 4s. 5d. Only 21 per cent. of the imports came from the United Kingdom, and only 18·8 per cent. of the exports were sent to the mother country. The value of the sugar exported was only £116,366, the lowest on record; of rum, £92,576, the average of the previous ten years being £133,257; of woods, £141,915, against the average of the antecedent ten years of £169,149. There is hardly any place in the world so well adapted for the manufacture of lime juice, but little is being done with it; coffee grows to great perfection in large tracts of the island, from 500 to 5,000 feet above the sea, but the trees are sadly neglected in most places. There is insufficient weeding and pruning, and it is rare to find a new plantation. Of rubber, which grows luxuriantly in Jamaica, there are only a few small plantations of *Castilloa elastica* (some damaged by the hurricane) which are not on a commercial scale, but would afford seed enough for any enterprising planter desirous of planting a large area. Great damage was done to the cocoanut trees by the hurricane of two years ago, the diminution in the export of nuts, in 1905, exceeding twenty millions, as compared with those of 1902-3. Even the orange export, from which so much is hoped, suffers from carelessness in gathering and packing. Nor can the experiments in cotton-growing be described as a success. In November, Messrs. Oliver and Stancliffe were deputed by the British Cotton Association to visit the colony and give advice and assistance to planters wishing to try the cultivation. But the cultivators wished to ratoon cotton (*i.e.* to take more crops than the first from the same stock by leaving the plants in the ground), which was strongly opposed by Mr. Oliver, both on account of the alleged inferiority of the cotton, and the risk of breeding and encouraging insect pests. The result was disappointing, only an export of cotton of 14,466 lbs., worth £546, to the United Kingdom, and of cotton seed worth £20 to the United Kingdom and United States. The prices realised were very good, and the cotton grown of very high quality. Sir Alexander Swettenham attributes the comparative failure of the cultivation to the ratoon difficulty, which, however, could be avoided by a rational system of rotation of crops, wherein cassava and the local peas (red peas and cow peas) or grain, should take their places; the existence of animal pests which require extermination at some expense and trouble; and the want of skill on the part of the local pickers. This last difficulty would of course disappear with practice.

The hurricane of 1904, which caused so much damage to the island, more especially to the banana cultivation and cocoanut trees, also caused a great diminution in school attendance; the percentage of the numbers enrolled which made average attendance falling from 63·5 to 60·3. The number of scholars on the roll fell off from 88,381 to 83,894, and the average attendance to 50,612. With returning prosperity it is hoped the attendance will improve. Some years ago the Government made arrangements for the transfer of Crown lands to cultivators upon easy terms, but the experiment has not been a decisive success. The Surveyor-General reports that "of the total of 31,189 acres there have been allotted nearly 3,000 acres, held by 250 lot holders, have reverted to the Crown by reason of default in payment of instalments of the purchase, or about 10 per cent. of the lands allotted. Most of the defaulters complain of the hurricane and hard times; but while the hurricane may in many cases have caused the default, in others it is an excuse for evading payment. So far as can be seen a much larger area of land allotted will eventually revert to the Crown, as while purchasers are always ready and anxious to pay down their deposits in order that land may be allotted them, they cannot be relied upon to keep faith and pay their subsequent yearly instalments of purchase money." The position of the island's finances is very unsatisfactory. The Treasury has incurred a debt to the Crown Agents of £88,600, and the Government, in the words of Sir Alexander Swettenham, is "compelled to defer not only all improvements but even many administrative expenses very desirable for better carrying out public duties."

THE CHARACTER OF ITALIAN EMIGRATION.

The number of emigrant passports issued by the Italian Government for the two years ended April 30, 1904 and 1905, was 471,191 and 726,331 respectively. In 1904, 168,789 emigrants left for the United States, and in 1905, 316,767; for Argentina, 51,779 and 86,158; for Brazil, 19,724 and 3079, and for other countries, 9,282 and 11,690. European, Asiatic, and African destinations accounted for 221,617 in 1904 and 281,607 in 1705. These figures do not represent the total number of emigrants embarked, and particularly in regard to trans-Atlantic emigration; they must be reduced considerably. According to the reports of the steamship companies engaged in this kind of transportation from Italian ports and from Havre, the total number carried to the United States in 1905 was 264,990, against 150,119 in the preceding year, but to these figures must be added the fairly large number of those who embarked at other ports outside Italy, which brings the totals much nearer the totals of passports issued. Italian emigration is to a surprising extent of a temporary character, and depends upon the season of outdoor labour. For example, of the 266,982 persons to whom emigration passports were issued last year for European countries, probably over 90 per cent. of those who actually went returned last autumn, or having departed in the spring of 1906 intended to return in November, when there is no longer the same demand for labourers. Indeed, this characteristic holds good also in trans-Atlantic emi-

gration, and is strikingly demonstrated by the crowded steerages of the Mediterranean and French steamers sailing from New York towards the month of December. This tendency to return is of the utmost value to Italy, and is encouraged by the authorities, who realise that but for it the £3,984,000 sent from abroad during the last four years through the Bank of Naples alone for the families of emigrants, or for deposit in the State savings banks, would have been very much less, and that if emigration were more permanent in character this important item in the finances of the country would diminish instead of increase. Of the £1,537,000 transmitted through this bank in the past year, £887,000 came from the United States. The American Consul at Venice states that the report of the Italian Commissioner of Emigration for the year ended April 30, 1906, does not estimate the total amount sent, but mentions that the average per capita of emigrants is £6. Therefore, taking the bare number of emigrants to the United States as reported by the steamship companies, the total amount sent would be about £1,600,000, and the calculation based upon the number of passports issued would give about £300,000 more—enough to feed some 20,000 families each of five persons of this class of southern Italians for one year. In its discussion of emigration to the United States, the report of the Italian emigration commissioners speaks enthusiastically of the meeting of the National Civic Federation recently held in New York, and of its attitude towards the bill for the exclusion of illiterate immigrants which was at that time engaging the attention of the United States Congress, and what threatened a valuable source of Italian revenue. There are more than 3,000 communal committees for the encouragement of emigration scattered throughout Italy, and what are known as associations for the instruction and protection of emigrants have sprung into existence in various centres without direct aid from the Government. In the year 1904-5 the sum of £2,000 was allowed from the emigration appropriation for the establishment of night schools for illiterates intending to emigrate, and numbers of these were opened in the south, where the percentage of illiteracy is enormous. This movement was started by the menace of the exclusion of illiterates from the United States, but now that the danger is past these schools are to be discontinued. The authorities also publish and distribute pamphlets on the subject of emigration, particularly of that to the United States. There is a decided tendency to discourage emigration to the North-eastern States in favour of the West and South, and as emigrants are under the direct control of the Italian authorities, from the time they announce their intention of emigrating until they are landed, the tide is expected to turn more strongly in the direction of the States where it is most needed. As it is, over 95 per cent. of the total number of emigrants remain in the North-eastern States where they are least desired.

ARTS AND CRAFTS.

Leather.—Though there may be nothing like leather, it is only within comparatively recent years that there has been any revival of artistic leatherwork in England. We have only to look in the most cursory way round any large museum to see examples of old leatherwork, whether cut, tooled, or lacquered, which prove that from quite early times leather did commend itself as a suitable material for artistic treatment, but for a while decorative work in leather (with the exception, perhaps, of bookbinders' tooling) seems to have died out pretty completely. Of late, however, leatherworkers appear to have been making up for lost time, and not only have various old processes been revived, but a great many experiments have been made, some of which have led to new developments. It was from Germany, and especially Northern Germany, that the first strong impulse towards the revival of cut and *repoussé* leatherwork of a really high standard of technical excellence came. There have been, and still are, in Hamburg and Berlin, trade workers who have done excellent work of this kind. And at the present time in Holland, heraldic work, rather hard it is true, but quite accomplished, is being practised. In England, as usual, the movement started on rather less technical lines—indeed, there is still a good deal of embossed and cut leatherwork being done which would be best described as "young ladyish." Still, however amateurish its beginning may have been, there is a very fair quantity of really good leatherwork of this kind being done in this country to-day. At many of the home art centres, notably at Leighton Buzzard and at Porlock Weir, to mention only some of the largest classes, excellent work is turned out.

Coloured Leatherwork.—With regard to the use of colour on this embossed work, it would be well to say a few words. The earlier revivers of leatherwork were for the most part content to leave their work in the colour of the leather in which they were working, with only the slight difference in tint made by the use of the tools, and more especially the hot tools. After a time they began to think that the work would be much more attractive if it were coloured. Their experiments, though pretty enough when first executed, proved more or less of a failure as the colours faded and sank in, but this difficulty has now been, at any rate in a measure overcome, and to-day a very considerable portion of English and French leather work is executed in colours. Speaking generally, the French work is more highly coloured, while the English inclines to paler and more delicate tints. Another kind of colour decoration which is being used abroad is the staining of a simple kind of pattern on to the flat surface of the leather, and this method is used for fairly large objects, such as chair seats and big portfolios. The colours used do not seem to be very nume-

rous—it is easy to understand that very pale or delicate colours would probably not stand—but those employed are quite enough to make the work effective. Perhaps the newest kind of coloured leather work is where the material is not merely slightly cut in order to raise the pattern, but is cut right away from the ground, leaving the pattern *à jour*—standing free after the fashion of cut linen work. (Of course, the patterns used are widely different from those employed in linen, as the square lines suited to a woven material are not called for in leather.) This work is coloured, and is, at any rate when it is new, very striking. It is well adapted to bands and other small objects, though when it is employed, say for a large collar, where it more or less competes with lace or silk embroidery, the effect is rather heavy, and, of course, it falls rather stiffly. It would seem as though a lighter and altogether more pleasing scheme of colour could be attained by cutting the pattern out of a piece of leather of one colour and mounting it on to material of a different shade, than by the present practice of tinting the leather differently in the various parts of the design. The most brilliant colour to be obtained on leather is got by lacquering, and this process has also been revived. For wall hangings lacquered leather has probably been permanently replaced by lacquered leather paper, as it is called, but lacquering on a smaller scale is still practised, and sometimes with very beautiful results. Indeed, this may really be described as quite the finest and most satisfactory way of decorating the material.

Various kinds of Leatherwork.—There is another direction in which the use of leather has also grown. We see now constantly little bags and other objects which are quite feminine in their conception made of soft leather and very often oversewn with strips or thongs of leather of the same or a slightly different colour. Indeed, some attempt has been made to do ornamental work in that kind of leather plaiting which we commonly associate with the north coast of Africa—somewhat after the fashion of kindergarten paper plaiting—though the English work has been mainly in the soft browns of natural skins instead of in the bright red, green, and white of the African plaiting. Again, though it is, I believe, only in its infancy, there is a movement towards leather embroidery of various kinds. Perhaps the most interesting is the kind of *appliqué* work executed in soft suède or chamois leather, which has, naturally, none of the stiffness which characterises work done in the heavier and stouter kinds of leather. Some of this work is carried out in the tender shades which we associate with ladies' suède gloves, and some is in tinted material, pale green, heliotrope, &c., which, if a trifle cold in tone, is at least fresh-looking, though it is impossible not to wonder whether it will stand. Boxes covered with leather and studded at intervals with heavy brass-headed nails are also being made, but nothing of this kind is apparently being done on a smaller and more refined scale like some of the old pouches, pockets, &c., in which the ground is broken by small nail-heads, or a pattern is formed of small silver-coloured nails or rivets. Again, though there has been some talk on the subject, no one seems to have done anything of importance in the way of reviving the work executed with peacock feather stems on leather after the fashion of the old Tyrolean belts. In short, whatever we may think of the directions in which its progress leads, leather has of late been making great strides, but it has not yet covered all the ground which it may legitimately hope to clear.

Textiles.—It is at this season that we begin to look once again for new developments in the designs for hangings, carpets, and so forth. Winter is almost upon us, and with the seasons, fashions change. With regard to hangings, the most noticeable alteration is the increasing numbers of all-over patterns, and the displacement of the very open patterns which were the only things shown some time back. The place recently filled by numerous so-called Old English crewel patterns, is being taken in tapestries and the like, by designs labelled "Portuguese." These are not so far removed in style from their predecessors as their title would suggest, being in point of fact copies or adaptations of that Portuguese, or perhaps more accurately Indo - Portuguese, embroidery which, as a matter of history, was the immediate forerunner of the English work. These modern adaptations, by the way, are apt to be rather strongly reminiscent of the English work which they are replacing. The carpet designs are rather fresher than they have been of late. The English makes show a leaning towards conventional patterns which are well suited to the coarse square mesh of the material, and they run to good rich colours rather on the lines of the best Turkey carpets. The French makes, on the other hand, are mostly in rather delicate colouring which suits their design—for in this kind of carpet the prevailing fashions are Louis XVI. and Empire. It appears to be a rule that no border should be rigid or even quite symmetrical. The open patterns which have lost their hold upon the hangings, seem in this instance to have gone somewhat lower and descended to the carpets. The well-covered, rather sprawling, up-to-date patterns which were so prevalent a little while ago, are rapidly disappearing. In connection with colour, it is rather interesting to note the change in the tints of the Persian and other Far Eastern carpets, which of late years have exchanged their accustomed rich and deep hues for the palest and most delicate shapes, which are sometimes so pretty as to suggest mother-of-pearl—but at the same time to raise the doubt as to how long there will be any colour in them once they are in wear.

GENERAL NOTES.

Graduation of the Compass Card.—Mr. F. Howard Collins, of Torquay, has forwarded to the Society an example of his improved compass card. This card is divided into 360 degrees, numbered continuously from 0 upwards, 0 (or 360) representing North, 90 East, 180 South, and 270 West. The card also shows the ordinary compass points, though only the four cardinal points and the divisions halfway between them—North-East, South-East, &c.—are lettered. The common practice now where the degrees are marked on the compass card is to divide the quadrant from North to East into 90 points and the other quadrants in the same way, each having its own numbering up to 90. This system has the obvious disadvantage that to indicate a point it is requisite to use two letters and a number, *e.g.*, North - East is then represented by N. 45 E., whereas if the card is numbered continuously a single number is sufficient to indicate any point. In that case North-East, for instance, is 45; South-West 225; and West by North (within 15 minutes of accuracy) 282. The suggestion is not an entirely novel one; prismatic compasses are always graduated in this manner, but Mr. Collins's card shows the degrees in a clear, distinct manner, while the ordinary compass points are clearly shown. The graduation of the compass card by degrees is a matter of growing importance, since, as is obvious, the course of a ship can be regulated with much greater nicety when steering to a degree than to the old compass points, and steamships, especially the long ships of modern construction, can be steered with more accuracy and precision than sailing vessels, although the lengths of the latter have enormously increased during the lives of seamen now living.

Belgian Contracts.—In his report on the trade and commerce of Belgium just issued (Cd. 2682), Consul-General Sir Cecil Hertslet comments upon the rarity of a British firm competing for public contracts in Belgium. And yet the Belgian authorities are singularly impartial in dealing with tenders. They are uninfluenced by nationality provided that the tender for the work of construction is sufficiently low to favourably compare with the offers of firms situated in Belgium. The Consul-General says the principal drawback to the free competition of British firms is the import duties imposed on most finished articles in the way of machinery. Another impediment is the difficulty in obtaining labour to carry out the contract if awarded to a British firm unless such firm appoints a representative on the spot to superintend the engaging of workmen and the carrying out of the construction, or whatever the work may be. Sir Cecil Hertslet suggests that, in view of the difficulties which have to be overcome in the carrying out of contracts by British firms, it might be better for such firms to devote their attention to the firms of Belgian nationality who have been awarded the contract and endeavour to supply them with the necessary material required in the execution of the works. For instance, most of the large towns in Belgium offer from time to time contracts for the supply and laying of paving stones for the streets and footpaths, which contracts are almost always awarded to local firms who can carry out the work at a lower cost than others established at a distance from the place where the work is to be performed. There would in such cases appear to be an opening for British trade in the supplying of the stone or granite for the work, and the endeavour of British firms should be to get into touch with and supply the material to local firms to which contracts have been awarded.

Indian Trade with Chinese Turkestan and Tibet.—The important feature for the year 1905-06, in the Yarkand or Central Asian trade with India, is the marked decrease in volume, both in exports and imports. The principal factor in this is the falling off, amounting to over one half, in the quantity and value of "charas" imported. These have long been the principal article of barter in exchange for European cotton goods, coral, and tea; and the heavy decrease in these commodities is said to be directly due to the enhanced import on charas—this has dealt a crushing blow to trade with Yarkand. A general decrease is also marked on the Tibetan trade. The import into India of raw wool steadily diminishes, and the value of borax as well. The reason assigned is the great mortality amongst sheep and goats, which has reduced both the quantity of wool and pasture available, and the means of transport, as both borax and wool are brought from Tibet on sheep and goats. The Punjab can absorb all the wool, and probably all the borax that Tibet can supply, and apparently Tibet can supply as much borax as can be collected. Increased trade, so we are told by the Commercial Intelligence Department in India, lies in popularising Indian and European goods among the Tibetans.

Corsica and Roquefort Cheese.—An industry which has been successfully established in recent years in Corsica, and which is spreading to all parts of the island, is the manufacture of Roquefort cheese. Factories, says Mr. Consul Holmes (Cd. 2682) have been set up by Frenchmen from Aveyron, and by others at Ile Rousse, Oletta, Francardo, Rosignano, and Ajaccio. The cheese is sold at from 1 franc to 1 franc 20 cents. the kilo, and is, most of it, sent to Roquefort, where it is matured and prepared for the markets of the world. Sheepowners, who formerly could make very little out of their milk, now find that they can dispose of it easily and remuneratively. The effect of this will probably be to increase the number of sheep, and reduce the number of goats (of which there is said to be 172,593 in the island). The harm the goats do is very considerable, and a reduction of their numbers will be looked upon rather as a gain than a loss to the country, more especially by those who have themselves suffered from the destructive habits of the animals.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

HOWARD LECTURES.

Professor Silvanus P. Thompson's Howard Lectures on "High-Speed Electric Machinery, with special reference to Steam-Turbine Machines," have been reprinted as a pamphlet (price one shilling), and can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

IVORY, IN COMMERCE AND IN THE ARTS.

By Alfred Maskell, F.S.A.

Lecture I.—Delivered April 23, 1906.

At the end of the present year it will be exactly fifty years, since Professor, afterwards Sir Richard Owen, read a paper on Ivory in this room. Amongst the audience was another famous man—Livingstone, the great African explorer—who also spoke and added his knowledge and experiences. It is not for me to attempt to vie with either the distinguished man of science or the traveller, but I shall endeavour to profit by what they said, for in the case of the first, at least, the information has neither been improved upon nor has it become stale. In the case of the other, circumstances have altered, as I shall show later on. Unfortunately, the elephant which provides us with the admirable material which forms the subject of my lectures has been driven further and further back into the wilds by the spread of civilisation, has been recklessly destroyed in vast numbers and is in imminent danger—if steps are not speedily taken to prevent it—of becoming, before many years have passed, totally extinct in its wild state, and therefore as the principal source of ivory production.

Professor Owen's lecture was confined to the scientific side of the question, to the structure of ivory and to statistical information. I propose, in addition, to carry you further and to put before you its commercial and artistic uses from the earliest times of which we have any written history—and even from prehistoric ages—down to the present day. I shall have, in so doing, this advantage over my distinguished predecessor. In addition to the specimens on the table, and a certain selection of works of art, I shall be able to throw upon the screen illustrations which photography renders with an exactness which could not have been hoped for in earlier days. And I may be allowed to say here, incidentally, that both the artist student and the scientific student owe to photography an immense debt. Even until comparatively recent times archæology suffered and has been the victim of the most erroneous conclusions and erroneous teaching which were repeated in text-books until they became accepted as true, due in great part to the imperfect and untruthful delineations of the draughtsman and wood-engraver. I think the same complaint may be made in the case of science.

Ivory! It is surprising how little concerning the use of this beautiful material is known to the general intelligent and even art-loving public. More than once lately the remark has been made to me—"What can there be said about ivory: I know it is used for knife-handles, brush-backs, piano-keys, and a lot of little knick-knacks which come from India; oh, yes, then there are those funny little things from Japan they call *netsukés*, but there isn't much else, is there?" Well, I hope to convince you that there is. No doubt, a very large quantity of ivory is used for ordinary objects of domestic utility, but almost since the world began it has also been a favourite

decorative material; so favourite, indeed, that appearing in some cases as a secondary adjunct only, its application passes almost unnoticed. To most people its connection with art represents India or China only; nothing more. Yet its association with the arts is universal in the history of civilisation; it is so intimately connected with almost every other substance employed in the production and adornment of beautiful objects that a close and systematic consideration of its various applications would seem to involve the study of the whole world's art in all ages. We shall find that even the graphic arts cannot be excluded, for in the decoration of ivory the subjects carved or engraved upon it and the practical use to which many of the objects which will come under our notice were destined will insensibly lead us to consider endless illustrations of the manners and customs of mankind from the earliest period of which we have any written account. Nay, more, we shall have to go back to a period in prehistoric ages when it may almost be said that the only records are graphic ones, carved or incised on this very material which is to occupy our attention. It will be a surprise to many, perhaps, to find that ivory has played so important a part in our civilisation, not only for domestic, but also for decorative applications. It would be easier, however, to enumerate amongst the industrial arts those in which it has played no part than those in which it forms the principal attraction. Nor is this surprising if we consider the intrinsic beauty of the material, its comparatively lasting nature, the brilliancy of the polish, and the peculiar delicacy of the colour, whether we may prefer this to rival the purest white of the finest marble or, on the other hand, to be of that semi-transparent mellow tint with which it is more generally associated.

We will, however, leave for a time the consideration of the innumerable ways in which ivory is employed in the arts and made to serve all kinds of useful purposes, and begin at the beginning with the sources from which it is derived, the methods by which it is obtained, its varieties, structure, and chemical constituents, and the statistics of its importation and exportation.

Strictly speaking, the term ivory is confined to the tusk of the elephant, and for commercial purposes practically to that of the male elephant only. Chemically it is something akin to bone, but it is not so brittle, or so liable to splinter. In substance it is very dense, the pores close and compact, and filled with a gelatinous or waxy solution, which contributes to the beautiful polish and renders it amenable to the tool of the worker. For a scientific definition of the nature of ivory we cannot do better than take Sir Richard Owen's, which I will proceed to quote. He says:—"The name ivory is now restricted to that modification of dentine, or tooth substance, which in transverse sections or fractures shows lines of different colours or *striæ* proceeding in the arc of a circle, and forming by their decussations minute curvilinear lozenge-shaped spaces." As a matter of fact almost everyone is aware of these peculiar markings, this engine-turned appearance, and is accustomed to be guided by them in determining, for instance, whether the handles of cutlery are ivory or imitation. Elephant ivory alone complies strictly with this definition; but besides the elephant tooth or tusk we shall have to deal also with the teeth of the hippopotamus, walrus, narwhal, cachalot or sperm-whale, and of some other animals which sufficiently approach it in quality, and are largely used for the same purposes. Our own teeth are of course sometimes qualified as "ivories," but it will be unnecessary to enter into the question of their construction. As we know too well they cease after a time to grow and to renew themselves from waste by use: on the contrary, they frequently cause us great pain through decay, and at last perish. The elephant suffers also from tusk-ache; a record toothache it must be. A celebrated instance was in the case of the Exeter Change elephant some hundred years ago or so: he had to be shot, and his skeleton and diseased tusk are now in the museum of the Royal College of Surgeons. The tusks of the elephant, wild boar, hippopotamus, walrus, many of the rodent tribe, and some other true, or nearly true ivory teeth, continue to grow during the whole life of the animal. First the pulp is formed—that is to say the matrix of the tooth enclosed in a capsule, which gradually gathers phosphates and other earthy matters from the blood, and becomes hardened. To this is added, by calcification of the pulp, the substance called dentine, by calcification of the capsule, what is called the cement and the intermediate substance or the enamel, when this is present. And so, as the animal grows, and during the whole of its existence, these substances continue to be added, and the growth and size of the tooth increase by fresh accretions of lime and phosphates, until

it is full grown; and still the growth of the formative pulp goes on as long as the animal lives. But after the attainment of full growth, the tusk is reproduced without increase in size, or at least this increase is in length only. In a longitudinally divided tusk there would appear to be no connection between the formative pulp and the ivory, but a strong microscope will reveal the very minute dentinal tubes.

The two permanent tusks of the elephant are preceded by two deciduous teeth, or milk teeth, which may be detected almost from birth. These make their appearance about the age of seven months, grow to a length of two inches or so—rarely more—and are shed between the first and second years of the animal's youth. We have Professor Owen's authority for this statement; other authorities dispute it. Here, however, is a specimen of a milk tusk, which I believe to have been shed. After the milk tusks come the permanent tusks, which continue their growth, taking a curved shape (because the sockets in the skull in which their bases are embedded are themselves curved), and diminishing in size to the apices. The curvature is sometimes equal to almost half a circle from the root to the point. I will show you presently on the screen, some abnormally curled tusks. On the other hand, abnormal growths, almost absolutely straight, sometimes occur. Saunderson, in his "Wild Beasts of India," holds that the milk tusks are permanent, and that it is an error to imagine that they are ever shed. This section of an elephant's skull will sufficiently illustrate the relative positions, and the proportions between the parts of the tusk which are without and within the socket. They are firmly fixed in the bone sockets of the skull; these run up each side of the head as far as the eyes. A very large proportion of the tusk, as you will see, is embedded in the socket. This is, of course, necessary when we consider the weights of the tusks themselves, and the great leverage exercised by the elephant when using them to lift heavy weights or in other ways. These great tusks are the upper incisor teeth of the elephant, and attain—as we shall presently see—in some cases an enormous development. They are hollow for some distance up, the hollow filled with semi-solid vascular pulp upon which the harder ivory is deposited after the manner of teeth generally.

Let us now proceed to consider some of the different species of elephant, both those which still exist, from which is obtained our principal supply of ivory, and also those prehistoric animals which in the very earliest periods of the earth's history were more numerous and more widely spread over the surface of the globe than the elephant which is familiar to us. I do not propose to enter into the natural history of the elephant generally, further than to state that there are two existing distinct varieties recognised by naturalists, the one confined to the African, the other to the Asiatic continents. Of the Indian elephant there are —for instance in the Indian archipelago—sub-varieties, sometimes strongly marked. As a certain amount of ivory is still supplied to the market from the immense stores of remains of prehistoric animals still existing throughout Russia, but principally in Siberia in the neighbourhood of the Lena and of the other rivers discharging into the Arctic Ocean, it will not be without interest to devote a little attention to the subject.

In the earliest periods of our earth's history elephants were much more widely spread over the surface of the globe than in later times. The true elephant roamed in countless herds over the temperate and northern parts of Europe, Asia and America. These were the species known as the mammoth (*Elephas primigenius*) and mastodon, and not only in Russia, but also throughout Europe their remains have been found in considerable quantities. For example, our museums include specimens discovered in Essex and off Dungeness, and so late as the year 1903 a very fine skeleton was unearthed in Kent. Nor can we have any doubt (remains have been found) that here, in what is now our London, the mammoth at one time roamed freely and grazed on the banks of that very Thames which flows but a very few yards from the spot upon which this building stands. So also in Paris, on the heights where now is reared the Basilica of Montmartre, and so also in every land where the revolution of countless ages has since planted the great cities and civilisations of the world. Even Australia, as Sir Richard Owen was able to say in his paper, appears to have had its huge proboscidean quadruped. The mammoth was a distinct species of elephant, though practically identical with our present Indian elephant and certainly not greater in size—a hairy animal protected in this way by a shaggy coat of reddish brown wool and black hair against the icy climate which prevailed in prehistoric times even so far south as the south of France. Even now the baby elephant is born with a good woolly coat as you can see from the specimen in the gallery in the British Museum.

We need not further consider the other early varieties allied to the African elephant of which remains have been found throughout the greater part of the world; the *elephas antiquus*, a specimen of which from Essex is now in the British Museum, the dwarf elephant of Malta and Cyprus, the *elephas ganesa* of India, the *elephas meridionalis*, inhabiting the south of France and north Italy, and others. A most interesting collection may be seen in our National Museum of Natural History. Nor need we linger over the other prehistoric species, the mastodon and its varieties, which range over India, Burmah, China, Southern and Central Europe, and throughout North and South American, most frequent on the banks of the Ohio. This slide shows the *Mastodon Americanus* in the British Museum, from the pleistocene, Missouri, coeval with prehistoric man, and this is the *Mastodon Avernensis* which inhabited our own islands, France, Italy, and Germany, a specimen from the upper Pliocene. There is a difference in the ivory, which has a band of enamel along one side. One interesting consideration is worth allusion. Science has been able to trace the evolution of the elephant's proboscis from the times when, small in stature, the animals browsed on the marshy plains of Africa, through the period when, their bodies increased in size, their legs got longer, their heads and chins became elongated, till by slow degrees at last was produced that wonderful prehensile trunk which, on attaining its full necessary length and the qualities which the experience of numberless centuries demanded from it, has remained since then in its perfected condition. Undoubtedly these changes occupied countless centuries, for Professor Ray Lankester, speaking lately in a lecture at the Royal Institution, referred to the remarkable fossils recently discovered by Dr. Andrews in the Eocene deposits of Upper Egypt, pig-like animals, yet foreshadowing in many ways the elephant to be, and he speaks of the Eocene rocks of Bognor deposited some thousand million years ago. On this slide we have the long-jawed mastodon with four tusks, two in the upper jaw, curved downwards, and two shorter ones in the lower jaw, and here again is the *Dinotherium giganteum* with the tusks curved downwards and backwards. The mammoth tusks found in Essex measure 9 feet 10 inches along the outer curve; that dug up off Dungeness and measured by Owen, 11 feet. We shall be able to compare these measurements presently with the trophies of our modern hunters. A few words more, and we shall have done with the general question of the prehistoric elephant. The Siberian mammoth claims a little more of our attention on account of the still existing vast stores of ivory which form even at the present day an article of commerce. The mammoth, if not longer in body, generally exceeded in size of tusks. They were much longer, much curved, with a spiral turn outward, approaching closer together at the root and spreading out laterally like two great scythes instead of forwards and backwards. Mammoth remains and enormous quantities of mammoth tusks have been found in Siberia since the beginning of the eighteenth century, when Adams travelled to see one as it lay on the frozen shores of the Arctic sea still clothed with all its flesh, and succeeded in transporting the greater part at least of the skeleton and some of the skin and hair to St. Petersburg, where it may now be seen in the museum of the Academy. The exploitation of these great deposits of various prehistoric animals, the ivory of which is still in a fairly perfect state, and commercially valuable, forms to-day a considerable industry. The attempt to explain the vast accumulations—the skulls and entire skeletons of elephants, rhinoceros, bison, and extinct pachyderms which fill mysteriously the frozen soil—is a subject of very wide interest. They are cemented together by *débris* of all kinds, by fossil wood and branches of trees brought down by the inundations for centuries of the great rivers, or as if at one particular period some frightful cataclysm had overwhelmed a vast extent of country, and sweeping everything before it, had collected and driven together in one tangled mass, gathering its accumulations as it proceeded, every living object in Northern Europe. For nearly two centuries these vast deposits have been worked for the ivory they contain. The store appears to be as inexhaustible as a coalfield, and it may be that when the supply of African ivory ceases—as some day it is thought it will—we shall be indebted to these mines for a source upon which we may still draw for this beautiful material.

The use of mammoth ivory is, I think, for the moment at least, declining in this country. Practically none has passed through the London sale rooms for the last two or three years. Before that a parcel of 10 or 20 tons was not uncommon. Perhaps about half of what comes in is good, the rest rotten. Here is a portion

of a tusk of no value for commercial purposes, and here is a wedge or section in beautiful condition when one considers the thousands of years it has laid hidden and preserved in the icy ground.

Generally speaking, it may be said that most of the ivory imported into Europe comes from Africa. Some is Asiatic, but much that is shipped from India is really African coming by way of Zanzibar and Mozambique to Bombay.

You are most of you doubtless aware of the passion for big game hunting which has in all ages incited the exploits of sportsmen. In modern times, none perhaps have so much excelled in the chase as our own countrymen. The pursuit of this big game, and the fascination of the wild life which it entails—besides, in the case of the elephant, the appreciable and valuable spoil resulting therefrom—have done a great deal in setting on foot the exploration and settlement of hitherto little known countries, and the opening up to civilisation of the vast tracts of land which, of late years, have excited for their acquisition and colonisation the energies of most European countries. Many are the books of travel and adventure which these redoubtable hunters have given to us. Household words are some of their names: who has not heard of Livingstone and Gordon Cumming, of Du Chaillu, of Mungo Park, of Speke and Grant in Central Africa, in the earlier days; of Captain Cornwallis Harris and his oft-quoted work, "Wild Sports of Southern Africa," of William Cotton Oswell and Baldwin in the first quarter of last century; and to come to our own immediate times of Selous and Buxton; of Sir John Willoughby, Neumann, Grogan and Arkell-Hardwicke, in Africa; of Sanderson, in India; and Sir Emerson Tennent, in Ceylon; and, the latest of all, the adventurous German hunter, Schillings, whose most interesting book, "With Flashlight and Rifle," shows us, amongst other wild animals and dangerous beasts, the less harmful elephant; all of them under conditions which only the camera and flashlight could accurately bring vividly before us. To read such books, and to look at such pictures, is to make almost every one long to start at once, and revel in the freedom of those boundless pastures, lakes, and rivers and forests teeming with every description of life, of savage beasts and birds and pachyderms.

I must only, in the time at my disposal, briefly glance at the countries which they traversed, in so far as they are connected with the hunting of the elephant and the acquisition of ivory. Africa is, of course, the most important habitat to-day of the ivory-producing elephant. In the speech made by Livingstone, at the conclusion of Professor Owen's paper in this room, fifty years ago, he spoke first of the difficulty of killing elephants with the weapons they then possessed—the natives only using arrows and slings—and how it would take sometimes fifty balls to despatch one. It is different now-a-days, unfortunately for the elephant. He went on to say that the number at that time in the southern part of the vast continent of Africa, had been stated by Gordon Cumming to be very large. Such was the fact, but on going northwards, he found the number increased wonderfully. On the Zambezi, he found an immense number, which, however, were not of so large a growth as in the south, where, though smaller animals, the tusks were larger, and this, with Professor Owen, he attributed to the fact that in those regions where the elephant had remained undisturbed by man, and passed a quiet existence, the tusks grew more regularly than in other parts where they were harassed: as in the south where firearms were used. At that time he considered the elephants north of the Zambezi to be so numerous that he could hardly imagine that they could ever become extinct.

The popular idea that the country of elephant hunting is somewhere about the Zambezi is not so very far wrong, and it will suffice for our purposes, for we are not so much concerned with the elephant itself as with its tusks, and the statistical information which I shall presently lay on the table will indicate sufficiently well the countries and districts whence our main supplies of ivory are derived. This map of Africa will show you the position of the various states and hunting-grounds, and what a great distance north of even the Zambezi the Equator is—the nearer to which we get the greater seems to be the quantity of elephants. Neumann for example in his work says that in 1893 he arrived at Laiju after about five weeks' caravan journey E.N.E. of Kenia in the Ndorobo country, and the head streams of the McKenzie river, which was his principal hunting ground. It is in these regions, he says, that the elephant attains its greatest dimensions both as to bodily bulk and weight of ivory. Schillings also hunted for the most part in the district of Mondorobo under the shadow of mighty Kilima-njaro, where the elephants de-

scend to the plains from the almost inaccessible heights and dense impenetrable forests, hardly likely for a great number of years to offer possibilities of European colonisation. In these immense and inhospitable tracts it is to be hoped the elephant may have some chance of continuing his race, and of postponing at least the oft-repeated prediction of the coming extinction of his species. In former days, in fact, the herds of elephants roaming over almost the whole of Africa—"from the Libyan desert to the Cape of Good Hope"—were, considering their numbers, practically undisturbed even by the most reckless of the savage tribes. North of the Orange River they are now almost extinct and few are left between the north of the Transvaal and the Zambezi. They are, however, abundant in Central Africa and Uganda, the country between Lake Rudolph and the Nile still shelters a large store of elephants, and they may be said to swarm round Kilima-njaro and in the wooded and marshy districts of the Masai and Mondorobo. Not so long ago elephants came down even to the borders of Natal. Drummond, in his "Large Game of South and South-East Africa," tells us that elephants were, in 1875, abundant close to the banks of the Limpopo and in the northern parts of Matabeleland. There are none now south of the Zambezi. It is everywhere the same, the same work of destruction going on from Abyssinia on one side of Africa to the upper basin of the Congo on the other, or civilisation driving the elephant further and further into the wilds. Fifty years ago the greater part of the vast continent was scarcely known to Europeans. Elephants, rhinoceros, hippopotami, lions, tigers, quagga, zebras, antelope, giraffes, buffalo, gnu, springbok, ostriches, eland, monkeys, and other fauna, roamed over the country in enormous numbers, undisturbed except by natives, and in vast tracts not even by them. A French traveller, towards the end of the eighteenth century, came across immense herds of elephants near Cape Town, and in the middle of the nineteenth century, what might be called moving masses of all the game we have just enumerated were seen, as Captain Harris tells us, in the neighbourhood of what is now Pretoria, in the Transvaal. Mr. Oswell, who hunted in the fifties of last century, relates that on one occasion he had seen four hundred elephants standing drowsily together in the shade of the mimosa, and there is the same tale of a vast and populous menagerie from every explorer and hunter up to comparatively recent times. Then came the era of the rifle and of great shooting expeditions merely for the sake of killing, which has gone on unceasingly and unchecked for forty years and more. On one occasion, in 1860, 25,000 head of various game were driven together and ruthlessly slaughtered. The bison has disappeared in America. Is it to be the turn next of the elephant, which, if for the sake only of his ivory, we can less easily spare? Already there has been a marked effect on the output of ivory, as the markets of Europe testify, except perhaps from the Congo Free State, which is still gaily engaged in killing the goose with the golden eggs. The cry of Schilling's, "Soon the ivory trade will be a thing of the past," is everywhere re-echoed. Formerly gangs of hundreds of natives of East Africa travelled with ivory to the coast, starting from Pangani. They journeyed through the country between the coast and Lake Victoria, taking a year or more on the road, and exchanging their wares for ivory, and at last returning to the coast with hundreds of tusks. In this way also large stores of ivory were accumulated by the native chiefs.

When we consider all this enormous drain on the supply of ivory in Africa alone which has been going on for centuries, the wonder is that the source has not long since been exhausted. The whole question is one which cannot fail to excite astonishment. To begin with, the mere number of elephants which roam over these territories and have to find means of subsistence is almost beyond calculation, and the supply of food which they must require is enormous. Literally, almost, they represent a forest of tusks, and it is not a forest which can be periodically cut down and renewed. It cannot be said that every pair of tusks represents a slain—but they mean a dead—elephant. Tusks are not extracted from living ones. Nor are dead ones that have died a natural death often found, at any rate, by hunters—I shall refer presently to native stores—or shed tusks in any quantity, though, as Schilling says, owing to the habit of using the tusks for tearing or chipping bark from trees for food, big pieces are sometimes broken off and may be collected. In India, according to Sanderson, not a single pair of ivories has ever, in his experience, been found in the Mysore jungles. The elephant seeks solitary valleys to die when he feels his time has come, but in India, at least, his spoil is then rare.

The consideration of the Indian elephant,

elephas maximus, whose ivory is of much less importance in the market, both in quantity and quality than that of his African brother, need not detain us long. The Indian elephant is found in considerable numbers in most of the great forests of the continent, from the Himalayas to the extreme south and in the Peninsula to the east of the Bay of Bengal, in Burmah and Siam. It is plentiful also in Ceylon, but there, although of the same species, it differs in one important characteristic, presently to be noticed. In a wild state it wanders in large herds, usually of from thirty to fifty head, but even a hundred are not uncommon. Some animals are of very large size, up, indeed, to 9 feet 10 inches in height, but this is perhaps a record; such a height as 10 feet is unknown in India. The tusks are much smaller than those of the African elephant. They are common to both sexes, but those of the female elephant are comparatively small, short and straight, and are seldom retained long, being early broken off from stripping bark and so on. The complete absence of tusks in the male is, as in Africa, of extreme rarity, in fact, a freak of nature. In Ceylon, on the contrary, a male elephant *with* tusks is very rare. Probably at least 99 per cent. are tuskless. The anomaly has never, I believe, been satisfactorily accounted for. It is of the same species as both the others and the climate and food are the same.

We turn now more particularly to the tusks themselves, and their uses—our principal subject to which I have endeavoured gradually, and as shortly as may be, to lead up. We have seen that the material of which ivory is composed is built up in layers, the inside layer being the last produced. The base of the tusk where it is embedded in the socket, and for some distance up, is hollow in a conical form, gradually becoming more and more solid as it is prolonged into a narrow channel, which runs along as a thread or, as it is sometimes called, nerve, towards the point of the tooth and is filled with a blackish matter. The bark, rind, or outer layer, is enamel, of no greater density, however, than the true ivory of the central part. It should be smooth and free from cracks. It is dark-coloured, and, as you see, partially stains the ivory within. The arrangement of tubes of which I have already spoken—very close together, radiating and crossing each in all directions—the engine turning on the case of a watch supplies a ready parallel to this—is the cause of the peculiar grain and the almost perfect elasticity of ivory. This grain, as you will perceive here, generally dies away towards the centre of the tooth, the outside being the coarsest. Compared with ivory, bone is much coarser, the structure less fibrous and the tubes larger. It is to its wonderful construction that ivory owes also its toughness and strength. This is no doubt essential when we consider the large mass of the tusk which projects to such a distance from the embedded base, and the weight-lifting, thrusting, and other uses to which it is applied by the elephant. Sir Emerson Tennent was of opinion that the elephant's tusk was useless to the animal. It is true that he was more familiar with the elephant of Ceylon, for there can be no doubt that it is continually used in fights between male elephants, and is, in many parts of Africa at least, absolutely essential in the stripping of masses of bark from the trees which form a considerable proportion of its food.

The tusks of the wild elephant that come to our markets vary of course considerably in length, in weight, and in quality. Those of domesticated animals seem to depreciate from all these points of view. When in the most perfect condition African ivory should appear if recently cut, of a kind of warm, transparent yellow—almost gamboge tint, with as little as possible appearance of grain or fibre. The gelatinous matter dries up considerably by exposure. Soft Indian or Asiatic ivory is of a denser white than African, less close in texture and not so hard under the tools. It is more disposed to turn yellow and does not take such a fine polish. Shortly, we may call the one opaque, the other transparent. Throughout the stretch of country between the east coast of Africa, in the neighbourhood of Zanzibar, and the Gaboon in French Congo on the west coast, what is called soft ivory prevails. When fresh, it varies between a strong yellow or pale blonde tint, which, however, bleaches after a time. East Indian ivory, as a rule, is very white indeed. East India includes Bombay, and it is the best quality and most expensive. Abyssinian is inclined to be a little "ringy" when cut. Unlike bone, ivory is in perfect condition for use and requires no cleaning or preparation. Tusks are valuable generally speaking according to their size. All below about 7 lbs. are called scrivelloes, and except those which are adapted for billiard balls, which are the most valuable of all, other things being equal would, of course, rank lowest. The ivory from the neighbourhood of the Cameroons is very good: then Loango, Congo, Gaboon and Ambriz: next the Gold

Coast, Sierra Leone and Cape Coast Castle: Gambian is not good. Egyptian is always more or less cracked and therefore cheaper. I had better say here that the references to the districts which I have mentioned may sometimes be misleading, because the ports of shipment have often more to do with the matter than the actual place of origin. For instance "Malta" ivory is a well understood term and yet there are no ivory-producing elephants now-a-days in Malta. The tusks should be rather tapering in shape, not very curved or crooked, on account of waste in cutting: for the same reason not with large hollows, and the coat should be fine, thin, clear and transparent. The loss in drying is not very great, say $1\frac{1}{2}$ per cent. Hunters take care to store their ivory with precautions against fire, for it is said to burn like a candle. It is very elastic or flexible, as you may see from this whip which has been somewhat extravagantly cut out of a whole tusk.

With regard to size and weight some particulars of very large tusks will be interesting. Size does not always depend on the size of the elephant, but on race: as already mentioned this runs larger in Equatorial Africa than in the south. Indian cow tusks are always short and straight. In India bull elephants' tusks, 9 feet in length and weighing 150 lbs., have been recorded; but as a rule it is very seldom that they exceed 50 lbs. Sir Victor Brooke, however, shot one in 1863 with, for an Indian, one very large tusk and one diseased one: the sound one 8 feet long weighed 90 lbs. Gordon Cumming had one, an African tusk, weighing 173 lbs.: others of 147, 150, 162, 164 lbs., are cited by him. This is a pair of fine tusks obtained by Sir William Garstin in British East Africa last year. One of them measures 8 feet 3 inches and weighs $135\frac{1}{2}$ lbs., the other 7 feet 11 inches but weighing $159\frac{1}{2}$ lbs. Neumann esteems his average at about 50 to 60 lbs., the heaviest pair of cow tusks he ever shot 38 and 39 lbs., the longest 9 feet weighing $117\frac{1}{2}$ lbs. This was from a bull elephant which stood 10 feet 9 inches in height. Sir Edward Loder's record was one of 184 lbs., 9 feet 5 inches long, and one presented to the present Prince of Wales on his marriage weighed 165 lbs. and measured 8 feet $7\frac{1}{2}$ inches in length.

Some mammoth tusks have been found of extreme length: the one dug up off Dungeness, for example, measured 11 feet, and the fine, very much curved ones in the British Museum, 12 feet 6 inches. Those of the extinct Indian elephant in the British Museum, which are very straight, are 10 feet 6 inches, 8 feet 6 inches of which is outside the head.

And so we come to those which, up to date, are the record tusks for weight and length. Two enormous specimens were brought to the Zanzibar market by natives in 1898: the pair weighed together over 450 lbs. One of them is now in the collection of Messrs. Rodgers and Co. of Sheffield; the other, and the finer of the two, is in our National Museum of Natural History at South Kensington. The price asked was £1,000, but I think that the one we have was obtained for a good deal less than £500. This magnificent specimen measures 10 feet 2 inches in length, $24\frac{1}{4}$ inches in girth, and weighs 228 lbs. Let us see what this means. It means that the animal carried in front of him tusks of fine ivory—for the ivory is also very fine and beautiful and of a perfect shape — projecting some eight feet perhaps, and weighing together 32 stone or four hundredweight, as much as two heavy men of 16 stone each. Imagine the perfection of mechanism in the animal's skull enabling him to use the immense power which these great levers would permit him to do. And so again for length. In Messrs. Rowland Ward's well-known establishment in Piccadilly you may see set up a pair of East African tusks, which hold the record for length if not for weight. Their lengths are 11 feet and 11 feet 5 inches respectively, and their combined weight 293 lbs. The price for which you may obtain them is £500.

Certain freaks of nature, as in other things, are sometimes found in tusks. For example, unusually straight ones occur, and this of course by no means a disadvantage, but the contrary. These are examples of some abnormally distorted tusks of the African elephant, the result probably of disease or injury. They are historic specimens of considerable interest, and are figured by Grew in his "Rarities of Gresham College," a work published in 1681. They belong to the Museum of the Royal College of Surgeons. That museum has been kind enough to lend me for exhibition several interesting specimens, which are now on the table: amongst them some examples of the curious effect of bullets found in tusks, sometimes completely embedded without showing any aperture where they entered. In these cases osteo-dentine is formed — a bone-like ivory, taking a sort of stalactite form. And though not true ivory, the molar teeth of elephants—of which I show specimens—are interesting. But though beautiful in section

they are utterly valueless. Several other freaks have arisen from disease. This is what is called a bubble.

There are other sources besides the elephant from which ivory as a commercial product is derived. The curved or canine teeth of the hippopotamus — hippo ivory — are valuable. These, as described by Owen, consist of "an extremely dense, compact kind of dentine, partially defended on their outside by a thin layer of enamel as hard as porcelain, so hard as to strike fire with steel." They are harder than elephant ivory, and therefore not congenial to the turner. This was the ivory that at one time was largely used for artificial teeth, but has now entirely gone out of use for that purpose, for which inorganic substances are exclusively employed. It is mostly used for umbrella and stick handles—whole for door handles and the like. The hippo, though a defenceless and stupid animal, is less hunted than the elephant, so that his ivory, if smaller and more troublesome to work, may still survive. It is plentiful in the almost inaccessible swamps of West Africa and in the rivers of Equatorial Africa—perhaps all over Africa, at least from the Nile to Santa Lucia Bay, but on the Nile and in North Africa, where it was formerly so plentiful, and whence it derived its name of river horse, it has disappeared, or is only to be found in the upper waters. In the trade the name for hippo teeth is not river-horse but sea-horse teeth. A very fine stuffed specimen of the hippopotamus is now in our Natural History Museum, one which for many years was familiar to most of us in the Zoological Gardens and the delight of children when he opened his vast mouth to have biscuits chucked in.

This is a very curious specimen of a sea-horse, or hippo tooth, not only on account of its great size, but also because of its abnormally curled shape, the result, perhaps, of disease, or some accident. You will observe the layer of extremely hard enamel which protects it. It is not at all liked by ivory workers and before it can be touched by them the enamel has first to be removed by acid, or sometimes by heating and sudden cooling, when it can be scaled off. This fine skull, kindly lent to me by Mr. George Pauling, the well known constructor of railways in Africa, shows you how the tusks and teeth are arranged in the great jaw; six, which are curved, in the upper, and six, straight, in the lower; and here is a large straight tooth from Messrs. Holland and Puddifoot's stores. The texture of the ivory is slightly curdled, mottled, or damasked. This also is a handsome hippo tooth from Messrs. Rowland Ward's Jungle in Piccadilly.

Walrus tusks at one time furnished a much larger supply of ivory to the market than they now do. The ivory is of fine quality, what there is of it, but there has been of late years an increasing scarcity owing to the terrible persecution to which the animals have been subjected. Between 1870 and 1880 no less than 400,000 lbs. of walrus ivory, representing about 100,000 animals killed, was exported from Behring Sea, and in a single season the Russians obtained 28,000 lbs. of walrus ivory from the Prybelow Islands alone. Our ancestors in northern countries used it considerably; many of the fine book-covers and other objects of mediæval ivory sculpture, especially about the eleventh and twelfth centuries are made from it. The walrus, as you see in this illustration, has two well-shaped tusks in the upper jaw, growing downwards outside the lower.

Walrus is less dense and coarser than hippo, the outer part, or true ivory, somewhat resembling it, but the oval centre has more the character of coarse bone. This centre, unfortunately, extends a long way up. It is little esteemed now, but I have been surprised at the comparatively large, fine slabs in mediæval ivories of the eleventh and twelfth centuries. Our ancestors seem to have thought highly of it, and the grips of most oriental swords, ancient and modern, are made from it. Present quotations are from 1s. 5d. to 2s. 5d. per lb. for sea-horse, and 2s. to 3s. a lb. for walrus. I had a little difficulty in getting a specimen for exhibition. This one has been kindly lent to me by Messrs. Myers, the well known ivory experts of Tower-hill. I am sorry I have not an illustration of the animal itself. You will remember the Walrus and the Carpenter in "Alice in Wonderland."

The narwhal is another ivory-producing animal, though its single tusk or horn is not of much commercial value except as a curiosity or ornament. The narwhal has, strictly, a pair of horns, in the male only, but one of them remains in an elementary condition and is not developed. The one which develops grows to a length of eight to ten feet—as in this specimen—four inches thick at the base. The substance is dense and of a creamy white colour, but the central cavity extends to almost the whole length: little is therefore left except for small things—serviette rings and so on.

This is a specimen of the upper tusk of the Australian dugong. I do not know whether any comes into the market, or is used. A considerable quantity of boars' tusks of various kinds also goes through the ivory sale rooms; mostly from India or the African warthog, of which this is a fine example, from Mr. George Pauling's collection.

Before we turn to a little statistical information—a dry subject, which I shall use only to derive a few interesting deductions from it—let us see how the ivory import trade is conducted and the method of dispersal of the product. London was not so long ago the sole great mart, but since the activity of the Congo trade Antwerp receives large quantities of ivory, and bids fair to displace London as the chief emporium. This is to be regretted, but it is not a question upon which free traders and tariff reformers could with the utmost ingenuity find any arguments to come to loggerheads upon. To the general public, the great ivory sales which take place at quarterly intervals in London are probably entirely unknown. The display of tusks and of ivory of all kinds which is laid out for inspection in the great warehouses called the "Ivory Floor" of the London Docks is, however, a very interesting and wonderful sight. A general idea of a portion of this floor, which covers more than an acre of ground, at the time when the ivory is on view previous to the sale by auction in Mincing-lane, may be gathered from the pictures which I now throw on the screen. The tusks and sections are, as you see, sorted out into classes and grades, and in addition there are hundreds of casks and sacks full of cuttings and shavings and scraps returned by manufacturers after having used what they required for their particular trade. Nothing is wasted: the shavings come in for inlayings, scraps for all kinds of small articles, the dust for polishing and for the preparation of Indian ink, and even for food, for ivory jelly — samples of which I exhibit — is a valuable product. There is not much stir and animation, and no attendance of the outside public. It is all business, by business people who know their business. Half-a-dozen or so intelligent and solemn-looking men wander about with the unwieldy catalogues in their hands examining the lots: the foreman or his assistant holds the tusks up to them one after another: an inspection of the cavity, a smart tap, conveying a great deal to the practised ear, a touch with a pair of callipers at a particular spot, a pencilled note, and the expert is able to form his judgment of the quality and value of the lot. Rhinoceros horns, as you will notice, are included, for some reason or other, in ivory sales.

Many as are the uses and applications of ivory, there is no greater demand—and that for the most valuable quality of all—than for billiard balls. What the number of billiard tables—not to speak of bagatelle boards and kindred games—throughout the world, each requiring its complete set, may be, it would be impossible to say, but it must be enormous. The manufacture of billiard balls is an interesting subject which, however, I must leave to my third and concluding lecture.

I have here some statistical returns showing the quantities of ivory imported and exported to and from the principal ports of the world. I shall not weary you with them in detail, but lay them on the table. We may gather from them the amount of ivory required annually for the world's consumption, and the countries whence it comes. London and Antwerp are the principal ports of entry, but although I have not included the figures in detail of other ports, we must not leave out of consideration Liverpool in England, America, Germany, France, and Portugal, which have colonial possessions in Africa, China and India. Schilling tells us that there has been imported from the German Cameroons alone, during the last ten years, 452,100 kilos., chiefly from young elephants. Mr. Buxton calculates the amount of ivory imported into the United Kingdom at about 11,000 cwt. a year—at least 500 tons. We will take this estimate for the present, and let us give the same to Antwerp, and leaving out of the question other ports, we have here for consumption no less than 1,000 tons. Then there are the German ports, Russia, China and Japan, though it is true the latter, at least, has been supplied from Europe. Still, it seems incredible.

Now I find that, in 1827, the principal London ivory importers imported 3,000 cwts.; in 1850, 8,000 cwt. The highest price up to 1855 was £55 per cwt. We have now reached a total import to the port of London, according to the Blue-books in 1904, of 9,045 cwt., of an average value, for Government statistical purposes, of £39 per cwt. At the July sales in London last year, a highest and record price was reached for ball, that is billiard ball teeth, of £167 per cwt. The drop, according to the Government returns, seems to have been pretty steady since 1890; from 14,349 cwt. in that year, to the 9,045 cwt. in 1904. What the

figures may actually mean is another question. For all that, there has been no corresponding rise in the price of billiard balls. It may be said, in fact, that the price of billiard balls is the same to-day as it was twenty years ago. It is not easy always to account for these fluctuations. One reason may be the large stocks which are held. Then again, there was a great demand from America for piano keys, besides billiard balls, and when America wants a thing it gets it, at any price. The high rate was not maintained at the next quarterly sale, when the highest price obtained was £135.

I don't think I need trouble you with an explanation of the terms used in the ivory trade, some of which explain themselves, while others are sufficiently mystifying to an outsider. There are, for instance, hard ivory and soft ivory, billiard ball pieces, bagatelle points, bangle ivory (which is exported to India) and cut-hollows which return from thence, cores and wedges, and so on. Sea-horse is the name—as I have already said, oddly enough given to the hippopotamus teeth. Scrivelloes (in French, *scrivailles*) is applied to teeth weighing anything under about 7 lbs., ball scrivelloes for billiard balls being the most valuable of all. The most important distinction is that between hard and soft. "Hard," or "bright" ivory is distinctly harder to cut with the saw, or other tools, than the "soft" variety. It has not, necessarily, a coarser grain; the quality of the grain is about equal in both descriptions. The terms are difficult to define exactly. The expert is guided by various considerations—by the shape of the tooth, for example, tapering to a fine point, or blunt like this one—and by the colour and quality of the bark or skin, and by the transparency when cut, or even before, as at the point of the tooth. To what the difference may be due I cannot say: probably climate, breed, and (possibly) feeding. Senegal and Gambia are very hard, but, roughly speaking, and remembering what I said just now about ports of shipment, one might draw a line down the centre of the map of Africa, or perhaps in this way, and say that the hard quality is on the West, the soft on the East. Bombay and Abyssinia, Soudan, Zanzibar and Egyptian soft ivory is, I think, a good deal used for the best quality piano keys.

Egyptian ivory is often cracked from variations of extreme heat and cold, in transit; more so formerly than now, since railways and better methods of packing. Ivory is liable to damage from sudden extremes of heat and cold. Where large quantities are stored, you will hear it crack occasionally. You should be very careful where you keep your billiard balls to prevent them warping. Don't put them on the mantelpiece. A tooth cracked within may be detected by looking down the hollow, or by tapping, as a railway wheel is tapped, but sometimes, of course, it is a case of buying a pig in a poke. However important the class or quality of the ivory may be, after all the great practical distinction is how to make the most of a tusk—how to cut it to the greatest advantage so as to get from the best portions the largest number of valuable articles without waste. I shall return to this subject when we come to consider billiard balls in my third lecture.

For domestic use, we start very early indeed in our lifetimes with the use of ivory. Here is a familiar object (a teething ring)—to those accustomed to nurseries at least—and I doubt whether any other material so admirable could be found to replace it. And if we are able to afford the luxury of ivory, instead of imitation, the question of our knife-handles is one of no little importance. In choosing ivory, I think the public generally rather likes to see a pretty grain, rather strongly marked: but the finest quality, in the hard variety which is generally used, is the closest and freest from grain. Then it should be a pure white. But some do not like this. Here are some samples of knife-handles in the six qualities made by the famous firm of Rodgers, of Sheffield. And two others are very fine examples of imitation in celluloid. You may examine them presently, but I doubt if everybody would pick out the best and most expensive ivory amongst them. With regard to the blades, you may be quite sure of what you are getting from this firm, because they use but one quality for all, and that the best.

Piano keys of course also consume a large quantity of ivory. Here are some examples of what are called heads and tails—that is to say the portions under the fingers and between the black notes—in various stages, bleached, partly bleached, and wholly bleached. I shall return to the subject in my third lecture. It is certain, I think, that the great rise in ball points last year was caused by the American buying of pianoforte ivory for home requirements and a great competition between two buyers. America is probably now the largest consumer, then Germany and France, but the English output is also very considerable.

As I said just now, supposing the London

market alone takes (according to the Blue-books: I am not referring to the Sales) 452—say 500 tons—of ivory annually, and giving a weight so high as 30 lbs. per pair of tusks (which is far too high—perhaps twice too high) we should have here alone between thirty and forty thousand elephants to account for—destroyed, or at any rate, dead. In addition, we have to reckon the ports of Antwerp, Liverpool and Hamburg, not to mention smaller ones, more than doubling the above quantity. Now it is not to be supposed for a moment that this number of elephants, or anything approaching it, is annually killed. The question is, where does this quantity of ivory come from, and beyond knowing that besides the large native stores which must exist, no small amount must be derived from what may be called elephant cemeteries—that is, recesses in the jungles where the animals retire when they feel their time has come to die—I think that no man can answer the question. I mean it is not possible to estimate the quantity now in existence derived from stored and accumulated ivory. We may call dead ivory 80 per cent. of the total import, but I think the matter is one of no small importance in relation to the continuance of the supply. How great are the stores, and how long can they continue to be drawn upon? Will they, perhaps without warning, some day come to a full stop. For my own part, I can only ask the questions. I have found no references in the accounts published by hunters and travellers, or in the information laid before our Government by the society for the preservation of the wild fauna of the Empire.

I have put together here a certain amount of statistical information which is at your service if you desire to make use of it. I do not find the returns in the Blue-books and the trade reports easy to reconcile. For example, the Blue-books state the total imports of ivory into the United Kingdom in 1904 to have been 9,045 cwt. (452 tons), while the trade returns show $220\frac{1}{4}$ tons as the imports at the London docks during the year, and the sales about 200 tons. We must also take into account the waste returned to sales, and perhaps we should be safe in averaging London (with Liverpool) and Antwerp annual sales at 250 tons each. A certain amount of very fine tusks, of course, are kept by hunters, or sold by them as trophies, and do not pass through the mart, but rather, direct into the hands of Messrs. Rowland Ward.

The figures I have quoted are perhaps liable to extenuating circumstances, but the lesson remains the same. It is surely of importance that steps should be taken to enforce regulations to prevent the total extinction of the wild forms of animal life — especially of the valuable elephant — throughout Africa. The principal colonising Powers—Great Britain, Germany, Spain, the Congo, France, Italy, and Portugal, it is satisfactory to know have advanced so far as to sign in London, in May, 1900, an international convention with this end in view. The difficulty is to enforce its application, and a faulty licensing system does a good deal to nullify the effects. Reserves have already been made. In British East Africa there is the Kenia Reserve; in British Central Africa there are reserves on the Shiré and around Lake Shirwar; in Uganda, the Budonga forest and the Toro Reserve; and the reserve in the inland vicinity of Victoria Nyanza includes hippo. But the question is surrounded by difficulties. For my own part, and considering ivory-producing animals only, I can see no practical solution except that ivory should be made a Government monopoly of the various colonial possessions, that the output should be controlled, and that it should be made penal to be in possession of ivory unregistered and unmarked. The main difficulty is that you will never get different—or rather indifferent—Governments to agree. Then, again, I am bound to say that the question arises whether, considering the vast hinterlands and illimitable forests, the elephant is in so much danger of extinction. Well, almost every hunter who writes books says that it is, and professes to be profoundly grieved. In the meantime he goes gaily along, slaying as many as he can. However important the subject, it is not, however, one which we have time to consider this evening. Yet I may at least take the opportunity of commending to the attention of those interested in big game the work and very instructive publications of the Society for the Preservation of the Wild Fauna of the Empire, whose offices are at 2, Temple-gardens, E.C.

The great centres of the ivory industry for the ordinary objects of common domestic use, such as cutlery handles, brush backs, piano keys, and billiard balls, are, in England, Sheffield and London. For English sized billiard balls, London; for piano keys, originally England: but the largest now is America, and there are France and Germany. Brush backs, almost wholly English: in London, principally Bennett,

Camberwell, and Kent, Farringdon-street; and for the numberless little ornaments and useful articles, such as statuettes, crucifixes, serviette rings, paper knives, little book covers, combs, and articles de Paris generally, most visitors to Dieppe are aware that a considerable trade goes on there. Then there are in France, St. Claude, in the Jura, and in Germany several important industries; India and China send us the multitude of toys, models, chess and draughtsmen, puzzles, and the like with which we are familiar. We shall return to these things, and to the work of sculptor-artists in Belgium, France and England, in the course of my third lecture. I need add but a word or two with regard to natural and artificial substitutes for ivory. These are for the first vegetable ivory, or the fruit of the Corozo tree or shrub of Brazil, and some betel nuts. Of vegetable ivory we imported, in 1904, 1,200 tons; and exported some 400 tons, so that the bulk appears to be consumed in this country. It is mainly and largely used for our coat buttons. Celluloid is more familiar to us, and of late years its use as a substitute for ivory is rapidly extending. In the form of bonzoline it is largely, and it appears very successfully, used for billiard balls; some first-class players even preferring it to ivory; and there is a new French substitute—a caseine made from milk —beginning to be much used for the cheaper sort of piano keys.

After so many dry details which I have, however, endeavoured to shorten and to put as concisely as possible, it will be, perhaps, a welcome relief as a conclusion of the first lecture of this course, if I endeavour to carry you rapidly (by means of lantern illustrations) through the history of the art applications of ivory, beginning in very early times. My second lecture will be devoted to the consideration of a very important archæological and artistic division, and my third to a more particular examination of the useful and decorative purposes which ivory is made to serve.

The history of ivory carving goes back to the most remote antiquity. Centuries before the Christian era we can point to examples in the days of the earliest dynasties of Assyria and Egypt. Far earlier still, recent discoveries in the cave-dwellings of the south of France have placed us in possession of the work of a people who existed at so remote an epoch that we cannot assign them any definite date in the countless ages which have passed since man existed, but must content ourselves—at least in this brief survey—with the appellation prehistoric. The earliest classical writers and the pages of Scripture teem with references to the use of ivory, its profusion, and the esteem in which it was held as a decorative material. Most familiar of very many in the Bible which I might quote is the reference to the great ivory throne, over-laid with pure gold, made for King Solomon by the skilled workmen of Hiram, King of Tyre, of which it is said that "there was not the like made in any kingdom." And again, in Ezekiel, "the company of the Ashurites made their benches of ivory brought out of the isles of Chittim." We have not many remains of the work of the fine periods of ancient Greek and Roman art, but of the time of the Consulates of the Roman Empire there have been preserved somewhere about fifty of the remarkable ivory plaques called Consular diptychs, which are a unique and valuable contribution to the history of those times. Then, again, after the establishment of Christianity and during the centuries of unrest and strife which we are accustomed to call the Dark Ages — when there is an almost complete absence of monumental sculpture, and a default in almost every description of learning and art—at least an absence of examples — it is to ivory that we owe the uninterrupted preservation of types and traditions from classic times to the Renaissance. It will be best—as our time is limited—to take each section separately, with a few words of introduction, as we proceed. You will bear in mind that I shall confine myself to salient points and typical instances.

The caves of the Dordogne have yielded the remarkable examples of the work of our prehistoric forefathers, of which I shall show you a few specimens. Who they were and at what date this people existed is a question impossible to answer. The investigations of geologists can deduce only some shadowy period in the distant ages of a far off antiquity in comparison with which the building of the earliest of the Pyramids — and that is at least a thousand years before the time of Abraham—is almost recent. It is certain that the climate of their days was very different from that of Southern Europe now, and there appears to be some evidence to connect these cave-men with the present Esquimaux. Certainly they lived at an age when the mammoth and elephant and the reindeer roamed freely over those regions which are now part of civilised France. Many fragments of carvings and engraving on ivory and bone have been found. The first which I

throw on the screen shows you—if you look carefully—a sketch of a mammoth drawn upon a slab of ivory, the product of that very animal. Here are some more sketches on reindeer-horn and ivory. It is impossible to help characterising these designs and carvings as absolutely artistic in conception and execution. The intuitive knowledge of these primitive peoples who in other respects were not removed from savages is nothing less than natural genius, with an innate comprehension of that which usually requires years of training and cultivation. Art is, after all, a convention and not a direct imitation of nature. Yet here we find, at a remote period of man's existence, this uncultivated savage instinctively adopting a convention, a system, a mannerism which no previous evolution could have led up to. It would not be surprising if we found of their handicraft that they had a taste for modelling in some plastic material — for instance, this figure of a seal—still our admiration and astonishment would not be so excited as when we are led to examine these examples of absolutely clever and artistic sketching. They are not drawn as a child would draw them, nor even in the manner which a sailor uses when he engraves figures of men and women, ships and animals in outline on sperm-whale teeth. Here is a specimen of such an engraved tooth. They are drawn by the hand of a genius who, in his way had nothing to learn, but from whose work his fellow-artists, uncounted generations later could derive much profit.

I leave with regret these extracts from the notebooks of our primitive ancestors. Many more exist of almost equal interest upon which much might be said. The question arises—and it is a natural one—are they genuine? I can only say that so far they have been subjected to the most searching investigations of numbers of distinguished men, amongst others, Sir John Lubbock, now Lord Avebury, and though forgeries of such things have been made, as of everything else, these so far as we can be certain of anything, are authentic.

The history of ancient Assyria is almost entirely wanting, and of its civilisation and magnificent cities there remain only mounds, and heaps of *débris* covering the ruins which for three thousand years and more remained unknown, until in our own days our countryman, Layard, at length unearthed them. Most people are acquainted with the marvellous and gigantic monuments, the huge winged bulls, dug up by him, now in the British Museum. But how many notice the two small cases, close by, containing about a hundred fragments of beautiful ivory sculpture from the same excavations? Many of them were in such a fragile condition that they separated into flakes and almost fell to pieces, and probably all would have done so before long had it not occurred to their discoverer to restore to the ivory the gelatinous matter which had dried up in the course of centuries. This was successfully done by boiling in a solution of gelatine and alcohol. Here are some examples. I may say that in the case of many of the specimens, time and perhaps fire, have considerably altered them so that some resemble ebony, basalt, sandstone, even opal, rather than ivory. Their age? Well, perhaps as old as Nineveh itself—say 2,000 years B.C.—and there are fragments of a similar kind from Abydos, which are possibly 2,000 years older still. It gives terribly to think, as the French say, does it not?

Diptychs were a kind of writing tablet, used by the ancients and indeed throughout the Middle Ages down to almost recent times. They were covered on the inner sides with a thin layer of wax, on which the writing was made or erased with a metal point or style. It was the custom of the Consuls on their inauguration to present such tablets to distinguished personages, and these presents were usually of fine ivory, often sculptured with the figure of the Consul himself. From about fifty to a hundred examples—ranging from the middle of the third to the middle of the sixth century A.D. are known, and as their date is certain, and the subjects of great interest, their historical value would be difficult to overestimate. The money value, should one hitherto unknown turn up, would be, I think—in more senses than one—a subject for speculation. Here are some casts of a few of these magnificent slabs of ivory, and I show others on the screen. Diptychs were also used for private purposes. This is an example of one of the finest known—a Roman diptych of the third century—now in the Kensington Museum. They gave £400 for it in 1865. The value of all works of art has of late years, as you know, risen in an inordinate degree. What such things as these and the mediæval ivories we shall come to presently would realise if now in the market it would be difficult to say. I should think for this piece £10,000 would be ridiculously within the mark.

For many centuries, up to the fourteenth, in all matters relating to art the Church was predominant. Religion formed the central interest

of peoples' lives. Art was the monopoly of religion, and so far, at least, as our immediate subject is concerned, it would be difficult to find much more than a dozen examples of decorative sculpture the subjects of which are other than sacred ones. But many of these things are of exceeding beauty—with a certain mannerism about them no doubt—yet admirable in their grace and refinement, full of suggestion and delicacy, charming in their elegance of treatment, of the expression of the figures and drapery. Here is first a beautiful example of minute workmanship, a panel perhaps of a casket or a book-cover, French work of the fourteenth century. And here is still more microscopic work, a veritable *tour de force*, for this little book-cover measures only six by four inches, and yet depicts with admirable art no less than thirty distinct episodes from the Gospel narratives. The next is a rare example of English ivory sculpture of the fourteenth century: rare because we have few examples of English work, and rare on account of its beauty of design and execution. This is an example of the devotional diptychs of the fourteenth century of which many beautiful examples have come down to us. I shall have more to say about them and their workmanship in my third lecture. Such things as these are the outcome, not of a commercial spirit or enterprise, not even of the purely æsthetic spirit which governed the artists of the Renaissance, but of the enthusiasm of pious minds, the noble expression of innate and fervent devotion. We must not forget also their teaching value. These diptychs and triptychs were, it may be said, the illustrated books of instruction of the time. Nothing is more wonderful than the way in which, in the compass of a few inches, whole histories and episodes of the scriptural narratives were compressed in the most vivid and telling manner. This is one of the many charming statuettes of the Virgin, which French art especially has handed down to us. And here are beautiful examples of fourteenth century pastoral staves or crosiers. Observe the elegant proportions and sweep of the volute, somewhat small and contracted, and diminishing from the point where it springs, to where the curve begins. It is to me unaccountable that the light and graceful ivory should not be more used for bishops' staves at the present time. It is in every way appropriate and convenient.

The exclusiveness of art for church purposes, in the Middle Ages, was not, however, absolute. Here is a casket, or workbox, of perhaps the eleventh century, with classical designs borrowed from earlier sources. And here are some examples of mirror cases, closing in much the same way as our ivory pocket mirrors or puff-boxes of the present day. The scenes upon them illustrate the old romances and episodes of social life. Combs, also, our ancestors thought it worth while to decorate. These are some specimens: Italian and English of the fourteenth to sixteenth centuries. And, of course, the elephant's tusk naturally suggested itself as a material for hunting horns and drinking horns, such as the next slide shows. When we leave the fifteenth and early sixteenth centuries and their pious usages, we are met by entirely new fashions. Whatever may have been the case with other arts, art in ivory declined. We come to the periods nicknamed *baroque* or *rococo*. In Germany these styles, together with appalling little nudities, ran riot, yet, especially in Flanders, some exceptions to the general decadence will be found to justify the attention which may be given to them. These are some plaques from a set in the Kensington Museum, attributed to one of the best of the Flemish artists, François Duquesnoy, generally called Fiammingo. And this is a very fine tankard—from the Jones collection—the finest that I know in ivory, probably by Fay d'Herbe.

Finally, for work of this period, we have this fine coin cabinet, entirely of ivory. The style and taste may not, perhaps, be of the very highest; still, for the period, it is at any rate a worthy, even admirable example. Ivory furniture also, in the shape of couches and chairs, is interesting and unusual. and I think our great upholsterers would do well to reintroduce it. These are two chairs from the Jones collection in the Kensington Museum. They are Indian made, after Chippendale or Adams, or French models. Such specimens are not, however, inexpensive. Mr. Jones gave £600 for two of these some twenty or more years ago. The art and industry of India, China, Japan, and the East generally, there is no time to-night even to describe and illustrate shortly.

It would not be difficult to run on with illustrations of this kind until your patience would be exhausted and your eyes weary. There remain but few words to add to carry us on, for the time being, to the modern use of ivory for decorative purposes and sculpture. I have found that a great many people otherwise

interested in the arts are quite unaware that sculpture in ivory in this present twentieth century is worthy of any consideration, or, in in other words, that it is practised by artists of distinction. I think I shall be able in my third lecture to dispel this misconception. Meanwhile I will put on the screen—as a fitting finish I may hope—this reproduction of the work of one of our best known artists. It is the "Lamia" of George Frampton, now in the Vivian collection.

My thanks are due to many kind friends who have supplied me with objects for illustration, amongst them Mr. Palmer (of the firm of Messrs. Hale and Son), Messrs. Myers, Messrs. Holland and Puddifoot, Mr. Richardson (of the billiard ball firm of Carter and Son), Mr. Rose (of Broadwood's), Mr. Johnson (of Messrs. Rodgers and Co., the great cutlers), Mr. Burlace (who superintends the Rowland Ward Jungle); and to many of them I am indebted for accurate information.

If I have covered, though briefly, a large extent of ground, if very much more of equal interest remains for us to follow, and if I have succeeded in interesting without sometimes wearying you, and have been able to put before you a little information which, if not altogether novel, may be new to some, I shall have justified my opening remarks—that there is much indeed to be said on the subject of ivory and its uses.

THE WORLD'S WINE PRODUCTION.

The world's yield of wine in 1905, according to the "Feuille Vinicole de la Gironde," amounted to nearly 4,000,000,000 gallons, distributed among the different countries approximately as follows:—France (including Algeria and Tunis), 1,710,000,000 gallons; Italy, 856,520,000; Spain, 428,000,000; Austria-Hungary, 192,800,000; Portugal, 108,320,000; Germany, 79,600,000; Russia, 76,620,000; Chile, 74,200,000; Roumania, 52,840,000; Argentine Republic, 34,350,000; Turkey, 34,300,000; United States, 34,000,000; Bulgaria, 29,100,000; Switzerland, 22,190,000; Australasia, 7,925,000; Servia, 6,605,000; Oceania, 6,605,000; Brazil, 5,600,000; Cape Colony, 4,490,000; Azores, Canary and Madeira Islands, 3,830,000; Uruguay, 2,780,000; Peru, 2,400,000; Bolivia, 610,000; and Mexico, 425,000 gallons. Europe produced over 95 per cent. of the total yield, and North and South America about 4 per cent. France alone produced 45 per cent.; and France, Italy and Spain combined, 78 per cent. It may be of interest to note that France is the largest importer, as well as the largest exporter, of wine in the world.

HOME INDUSTRIES.

The Price of Metals.—Reference was made in these Notes, in the *Journal* of September 21st, to the rise in the price of metals, and to the fact that in most cases prices stood at record quotations. Since then there has been further substantial advance, as will be seen from the following comparison:—

	September 21st.				October 27th.		
	£	s.	d.		£	s.	d.
Copper	87	0	0	....	97	0	0
Tin	185	0	0	....	195	0	0
Lead	19	10	0	..	19	15	0
Spelter	27	10	0	....	28	5	0
Scotch Iron	2	19	9	....	3	2	4

Whilst there has been further appreciation in all these metals, copper and tin show the largest increase. At one time last week, copper was quoted at near £104 per ton, or within £1 of the quotation in 1888, when the Secretan gamble was at its height. On the present occasion, the rise is due to a more legitimate cause, although it may be that manipulation has something to do with it. The main reason is, that demand has been greater than increasing supply. Production has increased largely—from 303,000 tons in 1893, to 566,000 in 1903, and 708,700 tons last year—but demand has increased in even more rapid ratio. The great expansion of shipbuilding, the ever-growing requirements of electric enterprises, the increasing demand for household appliances of all sorts, explain the comparative scarcity. Unlike tin, the known and unworked copper deposits of the world are very large. In the United States, in Mexico, in Siberia, and in South Africa, there are known to be immense deposits only awaiting the working. But it must be remembered not only that the means of easy transport have still to be created in many of the districts in which copper deposits are believed to be, but that much capital must be locked up for many years before returns begin to accrue. And between proved and profitable copper mines, and a mere opinion that they exist, there is a wide difference. In the last decade only two great producers of copper have been created—the Copper Range at Lake Superior, Michigan, and the Greene Consolidated in Mexico, and these two mines have only, at the end of six years, after an immense expenditure, reached the point of profitable production. No doubt mines that have been shut down for years are being re-started, but the total output of these mines cannot be large, and although copper at £100 per ton will check the demand in some directions this will be more than balanced by increased requirements in others. It is probable, therefore, that very high prices will be maintained for some time to come, however much new development may be quickened by ruling rates.

The Soap Industry.—It was mentioned in these Notes of September 14th that the leading soap-making firms intended to raise the price of their product, on the ground that there has been a serious increase in the cost of raw materials,

and it was shown that the price of two of the principal raw materials used—cotton oil and tallow—was not unusually high. Since then there has been much talk of a soap manufacturers' Trust, and a company has actually been formed, with a nominal capital of £12,000,000, for the purpose of taking over the interests of a large number of soap-manufacturing companies. The promoters of the Trust allege that there has been a rise in the price of the raw materials used in the manufacture of soap of 24 per cent—a statement traversed by some experts—and that the one object of the amalgamation is efficiency and economy. The first effect of the combination has been an increase in prices as between the manufacturers and retailers, and as the latter have not as yet altered their prices to the public the present loss is theirs. If the alleged rise in the price of raw materials is the one cause that has led to the amalgamation of the soap companies that are to form the Trust it is a little surprising since few industries have yielded the companies concerned with them better dividends than that of soap. For example, the company that is taking the leading part in the arrangements for the Trust has been in existence twelve years, and in that period its net profits have been £2,846,036, nor have the alleged high prices of the raw material reduced them. The present tendency towards amalgamation of businesses is to be regretted on many grounds. It means the dismissal of large numbers of men, the suppression of the small trader, the ultimate loss of the public, who are not safeguarded by that healthy competition which ensures good value for money. The interests of the public are not easily reconciled with those of these large combinations, whose chief object, whatever may be said to the contrary, is to put up prices.

Merchant Shipping and the Load Line.—It is not surprising that the Merchant Shipping Acts Amendment Bill, notwithstanding that its general object is to carry out the recommendation of three Committees, is meeting with considerable opposition, and being discussed with much persistency. It deals with complex and controversial subjects of great importance, and it is well that it should be very carefully considered. Nor is it surprising that the Government have been unable to accept the amendment of the Standing Committee on Trade last session with regard to the load line. As the clause stood in Mr. Lloyd-George's Bill the section of the Merchant Shipping Acts which relate to load line would "apply to all foreign ships while they are within any port in the United Kingdom as they apply to British ships," but as amended by the Standing Committee on Trade the clause read that the load line regulations should apply "to all foreign vessels while they are within and on all voyages with cargo to any port in the United Kingdom." This would prohibit the loading of any ship below the British load line at any foreign port, and would subject the ship so overladen to the penalties imposed under the Act. The objections to the amended clause are obvious and made it impossible for the Government to accept it, however irreproachable the desire that moved its authors. If it had become law the foreign shipmaster on arriving at a British port might be punished for doing in his own country that which he had a legal right to do. It is certain that foreign Governments would resent such legislation, and would retaliate, and reprisals might well injure British shipping abroad much more than it could serve it at home. Moreover, a ship might be overladen at a foreign port and yet by the consumption of her bunker coal on the passage be in proper trim according to the Board of Trade regulations on her arrival at a British port. The difficulties in the way of legislation affecting foreign ships in this matter of the load line seem unsurmountable, and only to be got over by the establishment of an international load line assented to and enforced by the laws of all the maritime nations. It may be hoped that the Government will take steps in this direction.

Motor Omnibuses and Depreciation.—The report and general meeting of the Motor Omnibus Company (Vanguard) has been looked forward to with interest as likely to throw some light upon the very important question of depreciation. At the meeting the chairman stated that the directors have taken as a basis of depreciation "after allowing for all maintenance and renewals out of revenue, what we consider will write off the whole of our stock in less than half our engineer's estimate of the life of the 'buses"—the engineer had reported that "the 'buses were more efficient to day than at the start, and that even the oldest of them was good for a life of ten years." This gives the motor omnibus a life of five years, and experience only can decide whether that is too generous an allotment, as many experts believe it to be. Meantime this particular company is able to show not only that it carried an immense number of passengers during the eighteen months covered by the report, but that it has carried them at a very satisfactory profit. "At the date of the report," said the chairman, "the company had carried about 18,000,000 passengers, but to-day this number was increased to nearly 30,000,000." The total of the gross revenue and profit from all sources from January 7, 1905, to June 30 last was £124,938, and the net profit, after making provision for depreciation, was £15,682, which enabled a dividend of 10 per cent. to be paid upon the capital, less than £60,000, in use over the whole of the period covered by the accounts. This profit was made with an average of 38 running omnibuses only. As to the risk of the present omnibuses being superseded by improved machines, the chairman treated it lightly. "Steam motor omnibuses up to now had not proved as successful or popular as the petrol-driven vehicle, and there was also the electrically-driven motor-omnibus, but the directors were advised that electric-power had not yet been made an economic success." It does not follow that it will not be sooner or later, and it seems a somewhat

bold assumption that the present petrol chassis have little to fear from new mechanical power.

The Steam Turbine.—Nothing in the history of engineering enterprise is more extraordinary than the rapidity with which the use of the Parsons' type of steam turbine is proceeding. From the report just issued of the Parsons' Turbine Company, Limited, it appears that the indicated horse-power of turbine engines in use, or under construction, for land purposes alone approaches two millions; and that during the last financial year the indicated horse-power of turbine engines constructed at the works has been 36,500, and by the company's licenses 93,78c. The orders received by the company during the same period amounted to 45,200 indicated horse-power, and by the licensees 227,460. In the first of a series of articles on the literature of the turbine, which appeared in the Engineering Supplement of the *Times* of October 24, Sir William White gives some interesting particulars of the progress of the turbine. The first Parsons' turbine was constructed in 1884, and developed 20 horse-power at a speed of 20,000 revolutions per minute. Now we see turbines of 10,000 horse-power working in generating stations on land, and in the great Cunard steamships now building each turbine will develop from 17,000 to 18,000 horse-power. The Admiralty have decided to use turbines in all vessels for the Royal Navy during the last two financial years. The Germans have constructed a successful cruiser; the French Ministry of Marine has decided to adopt turbines for at least three new battleships; the Navy Dapartment of the United States is seriously considering the subject. In the mercantile marine turbines are making way also, although not so rapidly. The Allan line and the Cunard line have already applied the system successfully to Atlantic liners; in Japan several large mercantile vessels are being fitted with steam turbines. To quote Sir William White, "On all sides little short of a revolution is in progress, and within five or six years of the real start with turbines for marine propulsion the enormous aggregate of nearly 900,000 horse-power of these machines is in use or in construction. The total horse-power of Parsons' turbines in use or construction for land purposes at present approaches two millions. All the leading British firms of marine engineers, and many foreign firms, have become licensees of the Parsons' system, and their collaboration in its development cannot fail to be most valuable." It is pleasant to know that in this propellant revolution England has from the first led the way.

GENERAL NOTES.

Optical Society.—Mr. James Aitchison has offered to present prizes to the value of five guineas to encourage junior members of the trade to study the instruments in which they deal, from the point of view of the user's requirements and convenience. The Optical Society therefore offer five prizes each of the value of one guinea for essays. The prizes are open to all under the age of 25 engaged in the optical industries. Candidates are allowed to select their own subjects in the following groups:—(*a.*) Telescopes. (*b.*) Microscopes. (*c.*) Photographic apparatus. (*d.*) Meteorological instruments. (*e.*) Any other widely used scientific instrument dealt in by opticians. The essays must be sent not later than March 1st, 1907, to the Hon. Secretary to the Optical Society, 20, Hanover-square, London, W.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 5...Farmers' Club, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. Mr. John McLaren, "Farm Implements in their Relation to Labour—a Retrospect."

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Sherard Cowper-Coles, "Recent Storage Battery Improvements."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Sir William Ramsay, "The Advantages of Investigating the Unlikely."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Sir Robert S. Ball, "Earthquakes and Volcanoes."

Tuesday, Nov. 6...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Inaugural address by Sir Alexander B. W. Kennedy (President).

Photographic, 66, Russell-square, W.C., 8 p.m. Opening Meeting of the Session. Reception by President, Exhibition, and Short Addresses.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

East India Association, Caxton-hall, S.W., 4 p.m. Mr. Navroz M. Parveez, "Indo-British Trade with Persia."

Wednesday, Nov. 7...Geological, Burlington-house, W., 8 p.m. 1. Mr. E. A. Newell Arber, "The Upper Carboniferous Rocks of West Devon and North Cornwall." 2. Mr. Henry S. Washington, "The Titaniferous Basalts of the Western Mediterranean."

African, Criterion Restaurant, 8 p.m. Mr. G. Wilson, "Uganda."

Cold Storage and Ice Association, London Chamber of Commerce, Oxford-court, Cannon-street, E.C., 7½ p.m. Mr. F. Knowles, "The Handling of Frozen Produce."

Thursday, Nov. 8...United Service Institution, Whitehall, S.W., 3 p.m. Captain H. T. Cantan, "Physical Training and its Advantages."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Carl Armbruster, "The Ballads of Carl Loewe."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Inaugural Address by the President, Dr. R. T. Glazebrook.

Friday, Nov. 9...Astronomical, Burlington-house, 8 p.m.

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FRIDAY, NOVEMBER 9, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One-hundred-and-Fifty-Third Session will be held on Wednesday Evening, the 21st of November, when an Address will be delivered by Sir STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council. The Chair will be taken at 8 o'clock:—

Previous to Christmas there will be five Ordinary Meetings, one meeting of the Indian Section, one of the Colonial Section, and one of the Applied Art Section.

The following arrangements have been made:—

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

NOVEMBER 28.—"Patent Law Reform." By JOHN WILLIAM GORDON. SIR WILLIAM H. PREECE, K.C.B., F.R.S., will preside.

DECEMBER 5.—"The Metric System." By COLONEL SIR CHARLES M. WATSON, K.C.M.G., C.B. SIR DAVID GILL, K.C.B., F.R.S., will preside.

DECEMBER 12.—"Fruit Growing and the Protection of Birds." By CECIL H. HOOPER, Member of the Council of the National Fruit-Growers' Association.

DECEMBER 19.—"Modern Developments of Flour-Milling." By ALBERT E. HUMPHRIES, President of the Incorporated Association of British and Irish Millers.

Papers to be read after Christmas:—

"The Straits of Panama." By PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company.

"The Principles and Practice of Insurance, and their modern Developments." By THOMAS EMLEY YOUNG, B.A., Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association.

"Smoke Prevention in Factories." By JOHN B. C. KERSHAW, F.I.C.

"The Underground Water Supply of the Thames Basin." By CLAYTON BEADLE.

"Engraving and Photogravure." By. J. CRAIG ANNAN.

"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc.

"Cold Storage and Food Supply." By HAL WILLIAMS.

"Modern Typewriters and Accessories." By ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

DECEMBER 4.—"The Cape to Cairo Railway." By THE HON. SIR LEWIS MICHELL, late Member of the Cape Ministry.

January 15, March 5, May 7.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

DECEMBER 13.—"The Indian Mohammedans: their Past, Present, and Future." By A. YUSUF ALI, M.A., LL.M.Cantab., I.C.S.

January 24, February 14, March 14, April 25, May 30.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

DECEMBER 18.—"Basket-Making." By THOMAS OKEY.

January 29, February 19, March 19, April 30, May 28.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

A. D. HALL, M.A., Director of Lawes Agricultural Trust, "Artificial Fertilisers: their Nature and Functions." Five Lectures.

LECTURE I.—NOVEMBER 19.—*The Nutrition of the Plant.*

LECTURE II.—NOVEMBER 26.—*The Fixation of Nitrogen.*

LECTURE III.—DECEMBER 3.—*Nitrogenous Fertilisers.*

LECTURE IV.—DECEMBER 10.—*Phosphatic Fertilisers.*

LECTURE V.—DECEMBER 17.—*Potassic Fertilisers. Consumption of Fertilisers.*

Prof. John Walter Gregory, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.
January 28; February 4, 11.

F. Hamilton Jackson, "Romanesque Ornament." Three Lectures.
February 25; March 4, 11.

Prof. Herbert Jackson, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.
April 15, 22, 29.

Juvenile Lectures.

Two Lectures suitable for a Juvenile audience will be delivered on Wednesday afternoons, January 2 and 9, 1907, at 5 o'clock.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Wednesday afternoon, 31st October. Present: Sir William Lee-Warner, K.C.S.I., in the chair, Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., T. J. Bennett, C.I.E., Sir M. M. Bhownaggree, K.C.I.E., Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., H. M. Birdwood, C.S.I., M.A., LL.D., Colonel Sir Thomas Hungerford Holdich, R.E., K.C.M.G., K.C.I.E., C.B., Henry Luttman-Johnson, General J. Michael, C.S.I., Alexander Rogers, Sir Charles Cecil Stevens, K.C.S.I., Thomas H. Thornton, C.S.I., D.C.L., Sir Raymond West, K.C.I.E., M.A., LL.D., with Sir Henry Trueman Wood (Secretary of the Society), and S. Digby (Secretary of the Section).

COLONIAL SECTION COMMITTEE.

A meeting of the Colonial Section was held on Wednesday afternoon, 7th inst. Present: Sir Westby B. Perceval, K.C.M.G., in the chair, Byron Brenan, C.M.G., Edward Dent, Carmichael Thomas, Sir William Hood Treacher, K.C.M.G., Sir Frederick Young, K.C.M.G., with S. Digby (Secretary of the Section).

HOWARD LECTURES.

Professor Silvanus P. Thompson's Howard Lectures on "High-Speed Electric Machinery, with special reference to Steam-Turbine Machines," have been reprinted as a pamphlet (price one shilling), and can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

IVORY, IN COMMERCE AND IN THE ARTS.

By Alfred Maskell, F.S.A.

Lecture II.—Delivered April 30, 1906.

Early Christian and Early Byzantine Ivory Sculpture.

I have taken for the subject of this lecture Early Christian and Early Byzantine Ivory Sculpture—that is to say, broadly speaking, the examples which have come down to us ranging in date from the fourth or fifth century to the tenth century. The questions concerning them are, I think, of considerable archæological importance; but although intimately connected, as they must of necessity be, with Christian art generally, I intend, so far as I possibly can, to limit my enquiries to sculpture in ivory, except only when it may be necessary for comparison to consider styles and traditions which have the common character of all Christian art of these periods. I do not propose to include those Christian ivories — very few in number—which may be ascribed to pre-Constantinian times: to times, that is, before the open acknowledgment of the Christian religion. I have selected a certain number of examples of ivory sculpture, detailed in the syllabus of this lecture, and I shall endeavour within the limits of time allotted to me to confine our attention to these as much as possible. They are all well known — that is to say as far as their aspect and subjects generally are concerned. With regard to the exact origins and dates, views differ considerably in many cases, and it is in reference to these differences of opinion that I shall venture to offer to the controversies which have arisen my own contribution. To cover properly what is in fact a considerable extent of ground would require a much longer time than it would be reasonable to give to one lecture. In order, therefore, to shorten the remarks which I have to make, I shall venture to presuppose in my audience some acquaintance with early Christian art, and with the examples of ivories which I have selected. I shall not, then, take up time by describing these examples or their subjects, and shall refer to each by some easily recognisable short title relating generally to the collections in which they are now to be

found; for example, the British Museum "Archangel," the Munich or Liverpool "Ascension," the Berlin book-covers, and so on; and in addition to the fictile reproductions of most of them, on the table, I shall, for comparative purposes, throw pictures of them on the screen.

Our knowlege of early Christian times and their art, is admittedly vague and full of problems and difficulties. The materials are wanting, to a great extent, upon which to form a judgment of their position. The persecutions of early days, the devastations of invading hordes, the sack of great cities and the consequent destruction of records have all combined to keep us in ignorance of much which relates to the social and religious life of those days. They were times of great unsettlement, and although we have a vague idea that the primitive Christians of the first three centuries, fleeing from persecutions, were compelled to remain in hiding, still it is not altogether certain that this state of things has not been somewhat exaggerated and that they did not enjoy, on the contrary, a comparatively large degree of freedom. At the beginning of the fourth century Rome, alone, had a Christian population of about fifty thousand, and in other parts of the Roman empire the great dioceses, amongst others, of Arles, Cologne, Treves, Lyons, Vienna, and Paris had already been founded. But as to their social condition history is almost entirely silent. During all this period of more than three centuries pagan and imperial Rome had been extending its conquests and increasing its magnificence under the first of its emperors and under the conjoined rule of emperor and consul, and at last suddenly—at one blow, or like the change of scene in dissolving views—paganism disappears under Constantine. Christianity, hitherto despised and persecuted, is no longer compelled to remain in hiding, veiling its religious rites under the forms of symbols often indeed borrowed from pagan sources, but becomes, in its turn, the ruling influence and the mainspring of the world's progress. How all this was accomplished, in what manner this great social upheaval actually took place, we know hardly at all. And if indeed we are so ignorant of the ordinary details of civil life—if we are able to gather so little information concerning it from the scarcity of any monuments of the arts which have come down to us, it is not surprising that our attempts at tracing the character and origin of the examples of the first efflorescence of Christian pictorial and sculptural art and their subsequent developments should also be hemmed in with difficulties, and sometimes by apparently unexplainable contradictions. Added to this, owing to religious prejudices, disputes innumerable have been waged around the archæological questions — especially of originality or restorations—involved in the study of the earliest Christian art of the West, that of the catacombs.

It is not necessary for my purpose this evening to pursue further the questions of these difficulties with regard to Christian art generally. I allude to them because the connection begins early. Certain of our ivories appear to derive their inspiration, if not from the frescoes and other decorations of the catacombs themselves, at any rate from the sculptured sarcophagi which carried on for several centuries the same traditions, and an accurate knowledge—so far as the researches of others have been able to enlighten us—of these traditions and of the character of symbolism and of iconographic detail, is necessary for our comparative study. Where difficulties and differences of opinion prevail on the one hand they must, of course, equally affect us on the other.

If, in the study of Christian art generally the want of material compels us to generalise, and to take refuge in speculative theories, the necessity is increased when in addition to the primitive elements the erection of the Byzantine empire, and the encouragement of art by Constantine impose their influence and further complicate the situation by so many new ideas derived from so many extraneous sources; when the results of the *va et vient* of trade and travel from West to East, and from East to West, produce an intermingling of elements foreign to both, and tend to increase still further the darkness in which we are groping. If the current notions concerning early Christian art are vague, vaguer still are the problems presented by that of Byzantium, and its early development in the West. Much and well as the question has been studied in recent years it can hardly be said that any consensus of opinion, which can be called definite, has been arrived at as to the epoch at which we may place its beginning. Was this in the fourth century, or perhaps in the second or third? Did it influence the art of the catacombs and the sarcophagi? Of what date and origin are the mosaics of Santa Maria Maggiore? Where did it take its rise—in Ravenna or in Con-

stantinople? What relations existed between the centres of artistic activity in the West, and the still flourishing settlements in Syria, the great cities of Antioch, Alexandria, and other industrial centres of Africa and Asia Minor? May we not hold with Diehl, and Kraus, and Kondakov that for the first two centuries after the peace of the church, Christian art was everywhere the same, in the East as in the West? Or must we lean to Strzygowski's theory that if it ran on the same lines before the time of Constantine, it then showed a new development, took the lead, and continuing the characteristics of ancient classic art, while at the same time assimilating the traditions of early Christian symbolism, reached its highest and purest form in the age of Justinian (527-567). Then again—and especially with relation to the ivories with which we shall presently have to deal—we shall find ourselves equally in the dark, and compelled to theorise as to the position of the immigrant Greek artists in Italy. Confining ourselves to our small sculpture, did they work independently or side by side with the Italians? did they initiate styles and impose their tastes, or did they work to order and in compliance with Latin ideas and spirit? What, later on, was the effect of the iconoclastic persecution? Finally, have we any evidence to justify us in assuming that in sculpture, so far as ivories are concerned, anything in the nature of "schools" existed, and that it is any more than guesswork—for which as much may be said against as in its favour—to talk about the school of Rome, the school of Ravenna, of Milan, or of Monza?

In quite recent years Byzantine history and art have received more careful study than they formerly did. They may almost be said to be becoming fashionable. Diehl or Strzygowski may yet lecture to duchesses at Claridge's hotel. Nor is it wonderful that it should be so, for the subject is full of attraction and poetry, alluring in its dramatic force and stirring incident. Still, there remain many prejudices to be overcome before the popular idea of its necessarily monotonous, stereotyped, barbarous, stiff, unbending character gives way to a more broad-minded reception of the story of the rise and extension of the Empire itself, its conquests and the invasions of its own territory, its relations with Islam, and its final fall, at last, under the Turk. All is tumultuous and exciting in the record from first to last of nearly a thousand years. And then its art and the splendour of its civilisation! The very name of Byzantium calls up a picture of unequalled wealth and luxury; of its marble palaces and churches; of the riches of two worlds; of gold and silver and embroideries, enamels and precious stones; of the golden age of Justinian and Theodora the dancer. What wonder if the spoils of the rest of the world gathered together to enrich Constantinople, laid the foundation of a new, if necessarily hybrid style; if from the hands and intellects of the numberless artists encouraged and employed by its founder proceeded the system which was destined to rule for centuries and impose its laws upon every description of art throughout the whole of the great Empire, extending to our islands and even to the most northern countries of Europe. At the same time, what were the exact limits of this influence, and how far it extinguished indigenous arts in the West, to the extent Byzantino-maniacs profess it did—are still matters of controversy. While some go to extreme lengths in the one direction others deny its part in the schools which flourished in Italy during the centuries with which we shall presently be concerned. There is a certain amount of reason in the latter position. The subject is more than a tempting one to pursue, but from the point of view which I shall presently take with regard to most of the examples of ivory during the four or perhaps five centuries after the time of Justinian I do not know that the relation to them of Byzantine art—except that my views will sometimes clash with some usually accepted conclusions—will be of the first importance. The centuries with which we shall be concerned—unless we must be forced to concede more examples to an earlier age when the art had attained the apogee of its first period—are those unquestionably of decay and stagnation. It may be true, therefore, that it is after all but a poor contribution to Byzantine art that we shall derive from these ivories. On the other hand, assuming the Byzantine elements, when we consider what the art of ivory sculpture is, how difficult, how it is thrown upon its own resources, demands the greatest restraint and dignity, owes nothing to the sensuous, lacks the colour of painting and mosaic, the grandeur of statuary and of architecture, we may well pause before we condemn. For it there is little scope for the Oriental likings for gorgeous surroundings and barbaric magnificence. These things are alien to the Western sobriety and intelligence which per-

haps exercised a restraining influence in the contrary direction. But so far as unquestionably Oriental specimens of Byzantine art in ivory are concerned, even in point of numbers, they are not many. That after the renaissance of that art we have some super-excellent examples—for instance the famous Harbaville triptych of the Louvre—is another matter.

I have endeavoured, though perhaps very imperfectly—for I do not find it easy to compress within a short limit of time the considerations of so large a subject—I have endeavoured to lead up to what will be the main points of the arguments relating to the early Christian and early Byzantine ivories which I propose to bring under your notice. These are as to how far many of them are connected with Byzantine art, and whether that term is to be employed with regard to them in a restricted or extended sense—that is to say whether they are of Byzantine art and workmanship executed in the East, carved by great artists in the West, wholly Byzantine in spirit, influenced by Western ideas, or carved by Western workmen copying or inspired by Eastern models and other sources of various kinds, or lastly, wholly Western and entirely unindebted to any Byzantine influences.

Early Christian and ancient and mediæval ivory sculpture have occupied the attention of archæologists and writers on art in recent years to a much greater extent than formerly when the subject was to some extent neglected. Gori, Bugati, Dragoni, Hagenbuch, Salig, Lenormant, and others of the earlier commentators still have their value, and in the last century, Labarte, Weerth, Darcel, Didron, Hahn, Oldfield, and one or two other English writers, bring us to about the last quarter of that century when, in addition to the author of the South Kensington catalogue, Westwood published his most useful and unsurpassed work "Fictile Ivories," which to this day is quoted and acknowledged by every writer on the subject. Molinier's splendid contribution to ivories was published so lately as about ten years ago, and quite recently German, French, and Russian authors have been especially active. I shall have to refer frequently to Graeven, Kraus, Stuhlfauth, Schultze, Schlosser, Dobbert, Goldschmidt, Haseloff and Strzygowski amongst many others too numerous to mention now. Nor, for Byzantine art, must Diel and Kondakov be forgotten; and for early Christian iconography and the art of the sarcophagi, Le Blant, de Rossi, Garrucci, Rohault de Fleury, St. Laurent, and our own Mrs. Jameson. The list is by no means exhausted.

We have little in England which can compare with the foreign publications. I am sorry to say it, but such work would not easily find a publisher. Literature of the kind is here almost forced to hold the balance between the scientific and the popular, and in so doing will almost inevitably satisfy neither. Such works as the Prussian and Vienna "Jahrbuchs" are, I believe, subsidised.

Unfortunately, the outline drawings that we find in Garrucci, Rohault de Fleury, Mrs. Jameson, and others, before the time of photographic illustration, are terribly misleading, sometimes even the casts also. They are accurate enough perhaps for some iconographical purposes, but, for a comparison of styles and epochs, we require for our study something more exact than these when we have not the advantage of actually handling the objects themselves. It is but too evident that the arguments of some distinguished critics have sometimes been derived from these imperfect representations: sometimes from misleading casts, as in the case of Didron when he was led into error about the Bodleian Codex cover. And outline drawings such as Mrs. Jameson gives us are so embellished and glorified as to be useless for comparisons of style and technique. Nor must we rely too much on iconographical details; they are not always infallible, and at least must be considered with other circumstances in the same way as we are guided by the Hall-marks on plate. Besides, they prove only what may be the earliest or most persistent examples so far as our present knowledge goes. At any moment a new discovery may be made to upset our theories, or we may be met with speculations as daring as Richter's with the mosaics of St. Mary Major.

We are always grateful for the plodding industry of the German critic, and we know how industriously he goes into the smallest details of his subject. But in the case of our ivories, Stuhlfauth, in his work on old Christian ivory sculpture, carries his minute analysis, I think, too far, and is led into all sorts of imaginary speculations and conjectures. He appears sometimes to be groping in the dark, catching hold of any supposed clue or fancied resemblance and running it to death. He seizes on some particular form—for instance, the shape of the faldstool in the Carrand St. Paul diptych, and at once dogmatically lays down the law that it is proof no longer open to

question of a certain date. He is fond of such expressions as "all other ascriptions are false," or of emphasising his dissent from the opinions of others by quotations, followed by one, or sometimes two, marks of exclamation; or, again, by making a reference and declaring in a footnote that it is hardly worth citing. Graeven, in his review of Stuhlfauth's book, pulls him up sharply on some of these points. And, further, on the very difficult question of the dates to be assigned to these early Christian ivories, he is not content with the possible exactness of a century or half a century, but tries even to narrow down this conjectural date to the first or last decade, almost as if we could be precise to a year and the day of a month. His division into schools is certainly painstaking, but I shall venture at once—for it touches a material point of the argument which I shall presently endeavour to establish—to express my opinion that we have no grounds to justify the assumption that schools of ivory existed. And by schools I do not, of course, mean only the ateliers of recognised masters, but that there was any stable and definitely followed system. I think that there was no distinct class of ivory sculptors any more than there is now, or than there was at the time of the great Flemish and German activity in the seventeenth century. Sarcophagi sculptors perhaps worked intermittently in ivory as marble and bronze sculptors do now. No doubt there was a class of factories for the production of the less fine consular diptychs, but these were hardly worth considering, however interesting they may be historically. To attempt to assign schools to different cities of the Empire—to Rome and Ravenna, to Milan and Monza, is as if we should take Frampton's Lamia and call it of the London school, or a nineteenth century statuette, unmistakeably French, and insist that it is of the school of Paris: either is English or French, and might as well have been executed at Manchester or Glasgow, or at Lyons or Limoges. Nor do the number and description of the examples which have come down to us warrant the supposition that the demand for those things and the artists who made them were in the cities or large towns. It was principally, I think, for book covers and reliquaries—the first chiefly—that ivory was required and the artists and sculptors were the monks—many of them Oriental—of the numerous monasteries throughout Italy, Gaul, and the Carlovingian empire generally. We have practically no remains at all showing that ivory was used for secular purposes and certainly not to such an extent as to lead us to imagine that schools or ateliers of ivory sculpture existed for general commercial purposes. There are the caskets of the Veroli kind, but these are isolated instances, though comparatively large in numbers, and of very uncertain date, and are probably a temporary revival when some exceptional artist or artists, I think in Italy, imitated, perhaps to some special order, the subjects and style of a much earlier period. I do not know any what I may call monastery work with which to compare them. We have few monuments which can be accurately dated. Not one single name of an artist has been handed down to us or any sign that they enjoyed any consideration whatever. Joel, of the Tournus flabellum, does not necessarily imply the name of the artist: and Tutilo, for ivories at least, is mythical. This, however, is entirely in accordance with the spirit of the rules of the founders of the great monastic orders. And when Stuhlfauth is not content with assigning a school to Ravenna, but actually divides this into the Old Testament and the New Testament schools, it seems to be carrying speculation too far. Does he mean that at the same period sculptors troubled themselves to work in a different way, with a different technique for one and the other.

It is to me an undoubted fact that in the same way that Byzantine art preserved its rigid conservatism for centuries, so for centuries the sculptors of these ivories copied and copied, and adapted from the models and manuscripts which, in one way or another—from their journeys, or from the influx of foreign monks and missionaries—found themselves in their hands. Chief among the influences which set a style, which long continued, were the sarcophagi of Rome, of Arles, and other southern cities of Europe. To these we may add as examples of comparative research the mosaics and frescoes, the illuminations of MSS. and the ornament of architecture—for of figure in sculpture, except the sarcophagi, we have next to nothing. Much of this covers a wide ground, for although the ivories which we shall consider are, for the most part, in my opinion of Western origin, we shall have to take into account the influence and the relations which existed, not only with Constantinople, but between the great governing provinces of the East—of Syria and Egypt—and the Western world.

A knowledge of Christian iconography and

symbolism is, of course, important. But however valuable, however necessary this knowledge may be, there is also the faculty which comes by experience—that species of *flair* which enables us to differentiate styles and technique. I shall return later on to the element of Syrian and Egyptian influence. In my judgment, in relation to ivories, it is not of the direct importance that is sometimes ascribed to it.

That the subject of early Christian ivories is full of difficulties, and still presents apparently insoluble problems, is evident from the great diversity of opinion amongst commentators on the question alone of the epochs to which to assign them; a question as undecided to-day as it was thirty or more years ago. Let us take a few of the most striking instances of this, remembering at the same time that with the exception of the throne of Maximian at Ravenna—and even with regard to this there may be qualifying circumstances—in the case of hardly one of the examples which I shall bring forward are critics in accord within a century or two. The Berlin pyx is assigned by Hahn to the third, or even the second century; by Kugler and Kraus to the fourth; by Westwood to the fourth or fifth; by Molinier to the sixth. The British Museum Passion plaques by Kraus, Dobbert, Schultze, and the museum authorities to the fifth century. Westwood gives the wide margin of the fifth, sixth, or seventh. Mr. Maskell, in whose collection they formerly were, to the seventh, and many others vary between these extremes. The beautiful Ascension plaque in the Munich Museum is assigned by Dobbert and Schultze, to the fourth or fifth, by Molinier and several others to the fifth or sixth, by Waagen from the sixth to the eighth, by Westwood to the ninth or tenth, by Förster to the eleventh, and Stuhlfauth and Kondakov place it in the middle of the fourth century, and make it the earliest of all our Christian ivory sculptures. The Carrand diptych with St. Paul varies between the fourth, fifth, and sixth, and even the Brescia casket from the third to the fifth century. The Bodleian bookcover is given by Kraus from the fourth to the sixth century, by de Rossi to the fifth, by Oldfield to the sixth, by Westwood to the ninth or tenth, and the author of the South Kensington catalogue considers it at least coeval with the manuscript of the tenth century to which it belonged. It is unnecessary to continue the list. It is curious how, when we think of the early centuries of our era, we insensibly treat the lapse of two or three hundred years as almost a negligible quantity. Let us see what this means. It is, as if in the case of a piece of silversmith's work, for example, we should be content to say that it is of the time of Queen Elizabeth, of Queen Anne, of George III., or of the last years of the reign of Queen Victoria. Much water runs under a bridge in the course of three hundred years. If then the margin of dates is so widely possible how can we be certain of the place of origin, or of the processes of evolution and copying of which these things may be the outcome?

Amidst all these conflicting opinions, although conscious that my views may be hazardous, and perhaps presumptuous in the extreme, I have long held the opinion that with regard to very many of these ivories, instead of carrying them back to the earliest speculative period, instead of assigning them to the age of Justinian we ought rather to postpone their dating from one to perhaps three centuries later, to admit that we cannot be precise even within these limits and to hold that they are the work of the monasteries carrying on for centuries favourite types and traditions, copying, adapting and reproducing from examples which they happened to possess and from notes and observations made on their travels or brought by stranger pilgrims and missionaries.

Within a century of the acceptance of Christianity monasteries had been founded in the West in considerable numbers and continued to increase. It would not be difficult to compile a list of over a thousand founded between the fifth and eighth centuries. The great monasteries were not as now-a-days imposing buildings, surrounded perhaps by a park, but vast walled-in enclosures, comprising and governing almost a town, such as we find to this day in Russia. "In the shades of its walls," as Montalembert says, speaking of one of them, "there dwelt a whole nation." They were situated often in remote and secluded places: comparatively seldom in the cities or their neighbourhoods. They were self-supporting, and we know that they were hives of industry, especially in the arts and in the making and illuminating of MSS. These latter required sumptuous bindings, and I think it is hardly likely that the monks would have sent to the towns for them. It is possible that the great cathedrals and churches of the empire, numbering by the time of Justinian over eighteen hundred, may also have required splendid book-covers and reliquaries, but even

if so, it is far more likely that in their case these would have been supplied by the monasteries. There were immense establishments as early as the time of St. Martin of Tours [A.D. 400] the apostle of Gaul, in the south of France, in Calabria and Otranto. Greek monks of the order of St. Basil came from the East, from the Nile, from Asia Minor, from Mount Athos to fill the monasteries of the West. They were workers, and they fostered and preserved what arts existed in the troublous times of the seventh and eighth centuries, when the great arts in Europe were almost non-existent. They were the artists, the miniaturists, calligraphers, and sculptors to whom we owe many of the ivory carvings we shall presently consider. Not only Greek monks and artists, but crowds of Irish and Anglo-Saxon missionaries swelled their numbers and contributed, under Byzantine influences to form a mixed art, tempered, as it could scarcely fail to be, by the Western surroundings, by the still existing monuments of classic times and the first Christian ages, and by the art of the calligraphers and miniaturists of the Celtic and Anglo-Saxon MSS. There must have been a struggle between these Eastern and Western forces even if the East dominated, and there would always have been a special incentive to interchange and to adapt from the MSS. and from the works of art—scanty in number—which the strangers brought with them, or the sketches they had made on their journeys. The chronicles of monasteries, such as those of St. Gall, of Cluny, or of Monte Cassino abound with references to the work of their monks in sculpture as well as calligraphy. From Leo of Ostia, the chronicler of Monte Cassino, we learn that great works were carried out—carvings in wood and ivory—and we are told that they were executed by Byzantine and Moorish artists. One name we know—Tutilo, the monk of St. Gall in the ninth century. Nor must we forget the founder of the great order of St. Benedict in the sixth century, whose rule expressly enjoins the cultivation of the arts. Doubtless also the iconoclastic persecution of the eighth century had the effect of driving numbers of artist monks from the Eastern to the Western monasteries. In those two centuries so commonly called the Dark Ages—dark, indeed, they were outside the limits of the peaceful monasteries—it is certain that the art of ivory sculpture must have been assiduously practised in these retreats, if only for the adornment of the magnificently-illuminated MSS. Then came the Carlovingian epoch, the Western Empire of Charlemagne and his successors, under whose rule the monasteries flourished more than ever. It is to ivories of this period that our attention will be frequently called. We shall be obliged in many cases to be contented with the general term Carlovingian, for, owing to the conservatism and persistent copying and adapting, national variations were not yet distinct enough to justify with certainty a more specific one. Nor do I think we need hesitate even in the case of such Oriental inspiration, tempered by models taken from nearer home, as in the Lorsch book-cover. We may remember that we call English the work of Solon, of Herkomer, or of Tadema. Shortly, it is not disputed that from very early days, before the time of St. Benedict, great monasteries were firmly established. There must have been in them a high degree of cultivation, for even in Merovingian times, and until the thirteenth century, nearly all were not only founded, but were also largely peopled by great princes and nobles. Contemporary writers testify to this.

In ivories, certainly, from the time of Constantine to the Byzantine renaissance, it is impossible to ignore the persistence of certain types carried from country to country, copied and imitated during many centuries. If there are variations they are not great, for models were probably scanty in number. With the Byzantine renaissance that art attained its zenith; but the examples of ivories are not many in which we find the qualities of this renaissance. They are, rather, of the class produced under the conditions upon which I am now insisting. Certainly, when we come to the ninth century or a little later, Oriental workmanship is easily to be distinguished. The Carlovingian sculptors evidently availed themselves of models which we can trace from the still-existing examples. I shall refer presently, for instance, to the Carrand St. Paul diptych, the Bodleian book-cover, and others, and it is, of course, from classical sources that the characteristic borders were, in some cases, directly borrowed. There is little evidence of originality and creative genius. The artists borrowed freely here and there: from the squat figures of the sarcophagi, whether directly or indirectly filtered through the mosaics. They availed themselves of Anglo-Saxon and Celtic MSS. with their foliated borders, or the looped curtains of classical art, and adapted the figures themselves; in fact from whatever fell into their

hands whether originals or sketches. We seem to find ourselves frequently in the presence of the natural born artist—I ought perhaps to say of the amateur rather than of the cultivated professional. Though there were no doubt schools or ateliers in the monasteries much as now would have been left to individual initiative: the designer and the sculptor were often, I imagine, not the same or of equal talent. For instance, in the Paris book-covers of the Lupicinus gospels, the sculptor seems to have carried out to the best of his ability designs given him perhaps by the graphic artists of the frescoes. We can well imagine the carver of the capitals of columns trying his hand at this smaller and more delicate work, doing his best but proving in the result that it was not in his line. It is difficult to believe that the sculptor of the Paris book-covers could have had before him the Berlin book-covers if it were from these that he drew his inspiration, or the originals of the small surrounding panels. Of the work of such exceptional artists as the sculptors of the Lorsch tablets, or the Munich Ascension plaque, little indeed seems to have come down to us. Here indeed is independent talent of a high order both in design and execution, and if they showed a fondness for and imitated the style of the sarcophagi it is to be remarked that it is strange they should have restricted their choice to comparatively so few models and subjects. We rarely find instances of the symbolism, especially that derived from pagan sources; the vintage scenes, the little genii gathering grapes, the sheep and lambs and rams, the goats, lizards, birds, the variety of crosses held by Our Lord, the good Shepherd, and so on; nor ornaments such as the strigil, which one would have thought they would have seized upon and adapted. Nor when so persistently copying and adapting do they seem to have availed themselves much of the many subjects, ornaments and styles of treatment to be found in the mosaics. The few to which they limited themselves suggest all the more that the sculptors were men shut up in remote parts of the country having access only to the few pieces of small sculpture and to the illuminations of MSS. which found their way to the monasteries or were produced there. I find little evidence to force the conclusion that the ivories in which we see resemblances to the art of the sarcophagi were necessarily executed directly from them, and still less that our ivory sculptors were acquainted with, or had ever visited the catacombs, of whose paintings and ornaments, abundant as was the material, there are no traces of influence whatever. We must remember also in the consideration of the examples which some authorities will have it, must be given to Rome that there were other places where sarcophagi abounded, the models for which very frequently came from the ateliers of Rome. In taking into account the influence of Anglo-Saxon and Celtic MSS., we must be careful to bear in mind the Oriental sources—Byzantine, Coptic or Syrian—from which the miniatures and ornaments of these MSS. were themselves derived.

Before proceeding to consider in detail examples which I have selected to put before you, we must cast a glance at the position of those provinces of Asia Minor and of Africa, which are held by some to have exercised a governing influence, not only on early Christian art generally, but also on these ivories. Lethaby, in his "Mediæval Art," asserts without further remark that the Ravenna throne was made in Alexandria, and attributions to Egypt and Syria are frequently made by others, without, however, any definite arguments or evidence *en appui*.

From an early period of the Christian era the state of civilisation of central Syria was very high. Towns and cities sprang up as quickly almost as in America or in Australia. The progress of Christianity was equally rapid, and, at first, pagan temples and palaces were converted into churches. Later on came the period of Byzantine architecture in the churches, and of these we have, from inscriptions, dates about which we can be certain in the sixth century. Then came the invasion and conquest by the Turk, and it would appear that almost as if by magic the country became desolate, the cities abandoned. There are still magnificent remains of the highest interest, awaiting exploration and research. That considerable trade relations and exchange of products existed between Syria and Egypt, the Syro-Egyptian provinces, and the West is certain. That specimens of art also came from thence to the West is probable, but from that to infer a persistent influence—I am concerned only with ivories—is, I think, a long step. I shall refer presently to a few instances in which there are grounds for tracing this influence and even origin. And we must not forget that in addition to the commercial activity it was from the two great provinces of the Eastern empire that proceeded the swarms of monks and pilgrims which invaded Southern Gaul and Italy at the period of the Merovingian dynasty. Briefly I must

content myself with referring you now to the labours of Strzygowski in his "Rome or Orient" and his investigations of Hellenistic and Coptic art in Alexandria: also to the work of Lake on the Greek monasteries of southern Italy. Graeven speaks of a large collection of ivory reliefs made in Egypt, lately brought to light in our British Museum, and not yet, he says, published. But for his recent and regretted death we might have expected, perhaps, to have heard from him more exactly to what he referred.

I propose now to examine successively a certain number of our ivories dating from soon after the establishment of Christianity under Constantine, according to some authorities, up to the ninth and tenth centuries. I shall not dwell long on the subject of the pyxes. They form, in a way, a class apart, and their origin and dating are of extreme uncertainty. Molinier is, I think, right in considering them, for the most part, of of Italian origin, under Byzantine influence. The Berlin pyx is of course the most famous. Dalton, in "Archæologia," describes the Sneyd pyx, lately added to the British Museum. He considers that our ivory pyxides were largely produced in Egypt, Syria, and Asia Minor, but that this pyx was made north of the Alps in the ninth or tenth century, and that it is one of the imitations of early Christian art comparatively frequent at that time. The British Museum possesses also a remarkable pyx with the martyrdom of St. Mennas: among ivories the earliest, and I think, for ivories, a unique representation at so early a period of a non-biblical saint. If we are to see in it, as Mr. Dalton does, a Syro-Egyptian or Alexandrian origin, it would seem that we must also put in the same category several of the plaques of the Ravenna chair. The type of face of the figures of the angels and those of the Ravenna chair—together with the drawing and technique—and I may include also those of the Berlin book-cover, to which we shall come presently, is, I take it, a borrowed type not to be traced to Italy, though several of this kind may be of Italian workmanship. In any case, the connection with the Mennas pyx—which I have not seen elsewhere alluded to—is of considerable importance. It is worth while, also, calling attention to the quite striking similarity of the martyrdom scene to one of the plaques on the flabellum of Tournus, evidence again of the various sources to which the Carlovingian monks went, either directly or indirectly. In point of fact their work is full of what we should now call anachronisms.

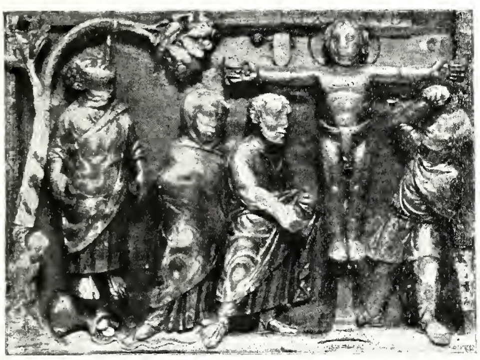
It is questionable, I think, whether the use of these pyxes persisted. They were properly reliquaries in which cloths imbibed with the blood of the martyrs was kept. Wafer boxes were different and later. I can see no trace of northern Carlovingian technique in the Sneyd pyx nor suggestion that it is not original save for the resemblance to the type of the figures in the Alcuin Bible which Mr. Dalton points out. But whence did these types and those of Carlovingian MSS. themselves proceed?

I come now to an important group of ivories, all of which—whether or no some are to be dated so early as the fifth or even the fourth century—are characterised by the style of figures and sometimes of composition, more or less adapted from the sarcophagi or from the classical monuments from which the sarcophagi themselves were derived, which appear to be so favourite and persistent during at least five centuries. The examples which I select are the British Museum Passion plaques, the diptych in the cathedral at Milan, the Munich Ascension, the Trivulzio Resurrection, and the Liverpool and South Kensington diptych of the Ascension and Entombment. Taking first the Passion plaques. These are, perhaps, unsurpassed in interest by any monuments of the first ten centuries which have come down to us. They were at one time in the Maskell collection, but I regret to say that I have no information whatever whence Mr. Maskell obtained them. Their *état civil* if it could be established would be of considerable value. Mr. Maskell considered them to be of the seventh century. The British Museum now dates them in the fifth, and I am bound to admit that the most recent authorities accept that date. One of the plaques—I imagine there were at one time more than four—represents the Crucifixion, and even if we should postpone the date to the seventh century it would still remain—with two or three hypothetical exceptions to which I shall presently refer, the earliest realistic representation of that sacred event.

How difficult it is for us to imagine the lapse of time represented by six hundred years and all the changes and developments which may occur during so long a period! And yet four hundred years at the very least go by after the foundation of Christianity before Christian artists dare to represent the Saviour, still less his sacred death, otherwise than

veiled under symbols. Nor was this veneration or reticence confined to the ages of persecution. After all it is hardly surprising that we should find in early Christian art a shrinking from representing a subject of such tremendous significance combined with a record of such cruel sufferings. Nor, indeed, do I think that we could calmly contemplate the representation even now, were it not that the custom of ages has turned the realism itself into a convention. Early Christian art was contented to suggest to the mind the meaning of the great act; it was unnecessary to call to remembrance the abhorred circumstances. Nor could it have dreamt of doing what was reserved to the sculptors and painters of the Renaissance first to make common—that is, an exhibition of artistic skill, a study in anatomy. So it

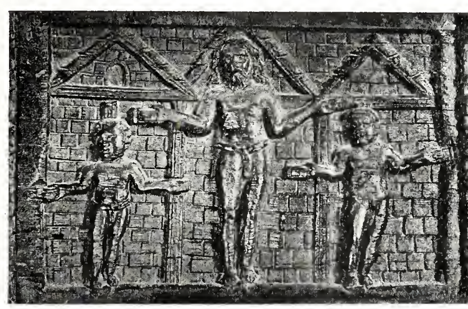
Fig. 1.



One of the British Museum Passion Plaques.

was that on the sarcophagi our Lord is represented as a joyous, youthful shepherd; sometimes, as on this sarcophagus of the fourth century, almost a little boy, bearing a small cross. More often in symbolism only, as in the Vatican cross of the sixth century, where it is the Lamb only at the intersection of the arms that represents the crucified body. So persistent were these feelings, that when the ideas of church discipline began to turn themselves in another direction, even then it was not until the eighth century that the Quinisext Council found it necessary to decree officially that henceforth the human nature of Christ should be rendered in pictures and sculptures instead of the mystic Lamb and other symbolical types which had hitherto prevailed. Now, apart from other considerations which I shall presently—as fully as time allows, though necessarily briefly—put before you, I cannot bring myself to believe that so early as the fifth century—with the evidences of opposite feeling of which we have innumerable instances—I cannot bring myself to believe that this crude, unabashed, realistic, irreverent (at least, in those days) representation would have been, as it were, suddenly sprung upon the world. Not only so, but if it had been, that it should have left no more mark on Christian art, made no more a revolution than the absence or paucity of any examples for several centuries at all approaching it obliges us to conclude was the case. I do not say that it does not differ from the feeling of Gothic times. It is still symbolism of a kind, for the Saviour is youthful, calm, smiling almost; there is no suggestion of cruel sufferings. (There are some doubtful allusions attributed to Lactantius which I cannot stay to consider.) Let us see now what other representations of the crucifixion

Fig. 2.



Panel of the Sabina Doors.

we have with which to compare it. They are first the wooden doors of the church of Santa Sabina in Rome, the miniature in the Syriac gospel book of the monk Rabulas of the end of the sixth century, and the Monza oil flask of about the same date. And there are some illuminated or calligraphic exercises in various psalters and gospel books, many of them Celtic or Anglo-Saxon of the sixth to the ninth centuries, to which it may be interesting briefly to refer. I shall not dwell on the questions involved in the story and subjects of the Sabina doors. They are, as you know, of cypress wood, the panels rudely carved with Scriptural subjects, including a very curious one, which is supposed to represent the crucifixion of our Lord and the two thieves. They are attributed by some to a Greek sculptor of the fifth century, but successive restorations create difficulties; and, apart from many subsequent events, when we con-

sider the sacking of Rome twice in this century, it is difficult to imagine that these wooden doors could have come down to us in their primitive condition. As a matter of fact, opinions have long differed, and all sorts of possible dates have been assigned. Agincourt goes even so far, and not quite without reason, as to compare them with Italian bronze doors of the twelfth century. Be this as it may, the workmanship is extremely rude, and suggests an uncultivated sculptor doing his best to carry out the designs of an artist certainly more talented than himself. But I am not concerned with attacking these doors: their connection with the Passion plaques has been made a great deal of. I merely suggest that if the question of the early dating of the latter should have to depend for support on this connection, it would be at best but a very slender support indeed. Stuhlfauth's very lively imagination makes him see and minutely dissect at great length the most surprising resemblances, at the same time admitting the differences. You will be able to judge for yourselves from these reproductions. On the one, as he admits, the Saviour is bearded, on the other smooth; here with, there without a nimbus or title. But, he says, all this is beside the fact that the body of Christ in both shows the same carriage, the same drawing, the same drapery, the same rendering, the feet without nails side by side, and on a suppedaneum. Now, you will remark that, on the doors, the feet are quite on the ground, without any trace of a support. I hold strongly myself, after long examination of the original ivory, that the nimbus is a subsequent addition, and I think also the inscription, the latter made after the plaques were removed from their mountings. The cross itself is of a form not unfrequently found on sarcophagi; for example, on that of Anicius Probus, in the church of S. Apollinare in Classe, and I need not dwell on the sarcophagus style of the carving, the squat figures, the flat-capped Jews, and the rest of it. The scanty drapery is a difficulty. This, together with the identical description of loin-cloth on the Sabina doors, is certainly unique. I know no other example with which to compare it.

I shall not trouble you with references to the accepted systems of drapery or clothing in various periods further than to remind you that in the Rabulas MS. in Theodolinda's reliquary, and in other early crucifixions, our Lord is fully clothed, or later on, has a skirt to the knees. We may take next the figure and action of the soldier with the spear, and remark that he is piercing the left instead of, according to the almost universal practice in representations of all ages, and, as in the Rabulas MS., the right side. Early representations showing the use of violence, such as we see here, are rare.

Fig. 3.

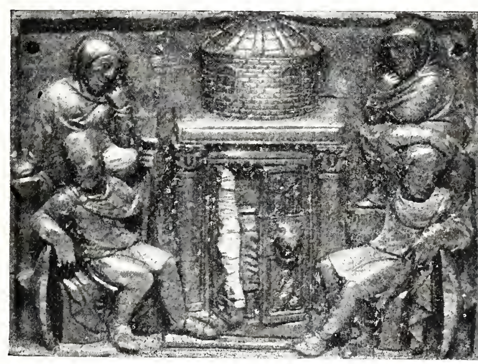
Leaf of the Milan Diptych.

Still, in the very curious and barbarous calligraphic *tour de force* representing the Crucifixion in the Irish MS. of the Gospel of the ninth century in the monastery of St. Gall, Longinus is clearly piercing the left side, as

well as in the Psalter of St. John's College, Oxford. If we compare these plaques with the Resurrection of the Trivulzio collection, the Milan diptych, and the beautiful Munich "Ascension," we shall see striking points of resemblance in the treatment of the subjects, in the attitudes and expressions of the personages represented, and in the architectural details and accessories. The technical treatment is not very different, though I admit the somewhat greater roundness and detachment of sculpture in the Passion plaques, the more stumpy figures in the Milan diptych, and the great artistic superiority of the Munich panel. All follow the lines of the sarcophagi, or the short stumpy models, perhaps from the arch of Constantine, from which the sarcophagi themselves were derived: the feeling, that and that they are of the second half of the fifth century. Waagen that they agree so much with the sarcophagi that they must be Italian, and not later than the fifth or sixth century. Westwood gives the wide margin of three centuries, and with this my views accord. I must remark, further, that he assigns definitely all the others I have taken for comparison to Carlovingian work of the ninth or tenth centuries. I would ask, supposing we had found these sculptures—always excepting the difficult "Crucifixion" one—surrounded by an acanthus border, should we have been surprised, or felt a difficulty in pronouncing? I make the same remark with regard to the Munich plaque. Finally, I should like—despite the sarcophagi, or not necessarily *directly* influenced by them—to recognise Byzantine feeling and tradition

Fig. 4.

Fig. 5.



Two of the British Museum Passion Plaques.

is to say, which was so persistent and popular. Compare with the Milan diptych the scene where Pilate washes his hands, the dismissal of Christ, the figure of Judas hanging, the tree itself, the sepulchre, the attitudes of the veiled women. One detail, I admit, disturbs me: that is the absence—or if not the absence, though I consider it a later addition—the treatment of the nimbus on the Passion plaques. But this presence or absence is a difficult question; never constant through the centuries. I suggest that the door of the tomb in these plaques is purposely shown broken in the original. As I have said, opinions vary greatly as to the origin of these Passion plaques, even if critics seem lately to accord a date so early as the fifth century. Molinier contests their Italian origin. Graeven makes them certainly Western on account of the Latin inscription, but this again I consider a later addition. Stuhlfauth holds very determinedly their connection with, but that they are later than the Sabina doors, and the work, perhaps, of Greek monks of the monasteries of Southern Italy.

Schultze connects the Milan diptych with the Passion plaques, with which he finds it in agreement, and considers it an example of Western art of the end of the fifth century. Molinier thinks it Byzantine of the sixth to the seventh century: Westwood and Stuhlfauth Carlovingian of the ninth or tenth, and Kraus inclines to the earlier dating. You are aware of the framing with borders, usually of acanthus and palm leaf, copied from classical sources, which are characteristic of Carlovingian ivories, so I need not further allude to them. Another characteristic, illustrated in this diptych, is that the nimbed angels are without wings. If therefore it is established—and I think it is—that after the fourth century angels were invariably winged, excepting only during a period from about the beginning of the eighth to the middle of the ninth century, the dating of this diptych is at least reduced within the limits of

a century and a half. The angels at the tomb in the Munich plaque are also unwinged, but some authorities claim that the date of this beautiful piece is actually before the practice began of thus adorning them.

The charming little plaque with the Ascension, in the Bavarian National Museum, is one of the most interesting with which we have to deal. I have already given you the widely conflicting opinions regarding its origin which prevail among commentators. Stuhlfauth—and Graeven is with him, I think—is persuaded that it is work of the fourth century, and therefore the very earliest of all our distinctly Christian ivories. He asserts also that it must have been made in Rome. To be assured, he says, that it cannot be Carlovingian we need only glance at the Liverpool Crucifixion plaque. But why the Crucifixion one with which there is no analogy? Why not the Liverpool and South Kensington Ascension and Entombment diptych? For my own part, and in continuation of my theory, I would suggest that it should be placed with the almost equally beautiful plaque representing the Resurrection in the Trionlzio collection. This piece is difficult to take out of Carlovingian times on account of the combined characteristics of borders or framing and wingless angels. I illustrate here with it the consular diptych of Probianus for the purpose of showing the obvious similarity, but I do not deduce that they are therefore of the same date. Molinier holds that they are, and contemporary with the beautiful "Symmachorum" in the museum at Kensington. The Munich panel is certainly a gem of ivory sculpture, surely by a great artist; but if, indeed, it might have to be referred to such an early period as the fourth century, even then I do not see that it need necessarily be of Rome. If any place other than a monastery could be specified, why not rather Ravenna at a time when at the end of the fourth and beginning of the fifth century that city was practically a Greek one?

A particular feature of representations of the Ascension is that of our Lord ascending towards the hand of the Almighty issuing out of a cloud. On the sarcophagi we find Moses

Fig. 6.

The Munich Panel.

Fig. 7.

Leaf of the South Kensington Diptych.

receiving the law from the hand of God in this way; on the Sabina doors, instead of the hand there are two angels, and the Transfiguration is also so represented. Is this plague then the solitary example of the Ascension thus treated so early as the period suggested? The subject is frequently found in a precisely similar manner in illuminated MSS. of the seventh century and after; for example, in the British Museum royal MS. gospel—Irish of the seventh century—and in the Corpus Christi College Latin gospels also of the seventh century. But Kondakov, if I mistake not (my notes are deficient), says that from the sixth to the ninth century the scene is nowhere represented in this manner, which began about the ninth only, and that therefore we must date the panel not later than the fifth. No, let us say not earlier than the seventh. Unusual and remarkable also in this piece is the undercutting of the branches and foliage of the tree. I know no other example in ivories with which to compare this treatment, and I certainly think that it tells against the very early ascription. In the half of a diptych in the Liverpool Museum representing the Ascension—the other half representing the empty tomb is at South Kensington—we have again the hand of God. But the Saviour is in the clouds, not mounting up a hill; the tree is a conventional palm, quite different to that in the Passion plaques, but like those in the Milan diptych, and the acanthus borders are exceptionally fine. Admitting the Latin models, the South Kensington leaf especially seems to suggest Byzantine feeling. I question whether we can be quite certain that both formed one diptych, or that they are both by the same hand. And I cannot think we have sufficient indications to enable us to say in what part of the Carlovingian empire they were made, or to be clearer as to date than the ninth or tenth century. Personally, I cannot accept the very early date ascribed by Graeven and Stuhlfauth.

Considering its beauty and importance, it is surprising that the ivory vase or pyx in the British Museum has received so little attention. For my own part, I know no references to it except a bare mention or two. Its origin and date remain an unsolved enigma. It was formerly in the Maskell collection, but again, as in the case of so many other of Mr. Maskell's important ivories, I have no information whence, or under what circumstance, he obtained it. In ivory sculpture it is unique—there is nothing like it either in form or decoration, neither can we do more than hazard a guess as to the use for which it was made and the meaning of the loose ring round the foot. But we have here, I think, an example in which we may reasonably see not only Central Syrian influence, but also a Syrian origin, and may

Fig. 8.

Vase in tee British Museum.

date it as early as the fifth or sixth century, at a time when undoubtedly the great cities of that province abounded in magnificent churches which were filled with rich objects for ecclesiastical use. At the time of the triumph of Christianity, the Christians of Antioch—the seat of the first patriarchate—numbered, according to de Vogüé, at least 100,000. I shall first point out two or three examples of Syrian

origin, from which it appears to me the decoration is derived, or to which, at least, the analogies are evident. These are, as illustrated on the same slide, first a fragment of the ornament of a frieze on the façade of the temple at Balsamin. You will remark the convoluted trefoil foliage, the little animals, and busts; and, *en passant*, note also the sixteen-pointed star which we find so frequently on caskets of the Veroli kind. This I consider distinctly of the Far East. I have added as another comparison a portion of the mosaic pavement of a small byzantine church, thought by de Rossi to have been completed at the time of Constantine, at Sour, where we find the same character and arrangement—distinctly Asiatic—of branching foliage, the same little animals, and birds. I show also the silver mirror with foliage, dogs and goats of the Blacas collection, of the time, perhaps, of the sack and destruction of these provinces and cities by the Mohammedans.

Finally, I would put in a plea for the consideration of a suggestion which I hope to be able at some future time to elaborate. It is that we may consider the Christian communities which were settled in very early days in India and in Ceylon. I need only now refer briefly to the legend of St. Thomas and the missions of Pantænus. The connection of the early Christian colonies of India with the Nestorians of Syria and Alexandria is certain, and in 325 A.D. they appear to have been in the patriarchate of Merv. The chronicle of Cosmas in the time of Justinian tells us that throughout farther India and Persia there was an infinite number of churches, with bishops, and a vast multitude of Christian people. It was Syria which took Christianity to India, and the faith they took—Nestorian, or what you will—however it may be qualified is, to this day, represented by the Syrian Christians of India and Persia. The decoration of the foot of the vase, to which there is elsewhere no parallel, I think, in early Christian art, is to me unquestionably the lotus. I would call your attention to this silver bowl and cover, at one time in my own possession, now in the Kensington Museum (Fig. 9). I am not certain of the origin, but think it is Cingalese. The only conclusion I can come to for the present, is that the ivory vase possesses defined elements of the farther East, that it is due to the relations between Syria and Nestorian Christian India or Ceylon, and that it is possibly of Indian workmanship. Technically, I hardly think it was hollowed out in a lathe, but probably with gouges of some sort worked with a bow; in that case, there was a considerable waste of material which the removal of a cylindrical core would have prevented. The loose ring is certainly tricky.

The famous ivory throne of Maximian, at Ravenna, is an undoubtedly early monument, and, so to speak, type piece of other early Christian and Byzantine ivories. It is practically dated, that is if we can accept the monogram of the bishop who sat in the see of Ravenna from 545 A.D. to 556, as evidence that it was made for him as we find it now. The differences of opinion concerning the ivory sculpture are mainly on the question whether it is of Oriental or Western workmanship. All

Fig. 9.

Silver Bowl.—Kensington Museum.

the plaques are certainly not of the same artistic merit, and it would seem most probable that several sculptors worked at it under the superintendence of a Greek sculptor, who himself executed the finer portions. Possibly, in later times, some of the plaques were collected from various sources. It seems to me hardly likely that in its original condition they were so incongruously and not very artistically fitted into the front, sides, and back. Although Stuhlfauth hotly asserts that in substance and kernel the chair is Italian, and the direct continuation of the early Christian schools of Rome and Milan, as he calls them, it would be difficult to avoid the conclusion that it is practically Byzantine, and should thus be qualified. Michel, in his lately published "Histoire de l'Art," ascribes it to Egypt, at a time when Alexandrian traditions had become weakened

and rather favoured a certain archaicism. It would, indeed, be very much to be desired that such an important and imposing monument should, by means of casts, be represented in its entirety at South Kensington. It is interesting to compare the plaques of the history of St. Joseph with the Berlin book-cover, and the imitation of this in the book-cover of St. Andoche, with the Paris or St. Lupicinus book-cover, with the Etschmiadzin cover, and with the St. Mennas pyx in the British Museum. The conclusion, I think, to be drawn is that these and other existing examples hang together, some being coeval with the chair, others inspired or copied from the plaques which compose it, either directly or indirectly. I therefore group them together, and will take first the book-covers in the Kunst-Kammer, Berlin. The cover representing the Virgin and Child has always had a peculiar attraction for me, on account of its unusual nature and the problems which its character involves. In the first place, it appears to be singularly wanting in the slightest spark of a devotional idea. It might well be the representation of some great empress with her child on her lap. The expression on the face of the Virgin is bold almost to effrontery. Leaving out of the question some irreconcileable iconographical details, I find it difficult to believe that at so early a period as the sixth century, to which these plaques are ascribed by some, the Virgin could have been invested with such attributes of authority and magnificence. I do not forget the representations in the mosaics of Sta. Maria Maggiore of the fifth century, or, if we could accept Dr. Richter's theory, much earlier, in which the Virgin is placed in a richly-decorated chair with two angels standing behind. But this is a picture of the Annunciation. In the ambon at Salonica she is seated on a kind of throne-like chair with the child on her lap. In the Berlin piece she is too much the principal figure. Then, although the details are much worn, if we look at the face of the Holy Child, it may be said that nowhere in ivories of so early a date do we possess a representation so statuesque, recalling the manner of centuries later. Assuming the connection with the St. Lupicinus book-covers or with the original from which these covers themselves were derived, we can trace back to the plaques on the Ravenna chair of the journey to Bethlehem or of Joseph sold by his brethren; the similarity is striking even to the expressions of the faces. Stuhlfauth asserts that Westwood unhesitatingly ascribed the Berlin covers to the same master who executed the figures of the Baptist and the Evangelists on the chair. Hardly so: he only says that the former are the only pieces which at all remind him of them. That the arrangement is derived from the consular diptychs is evident; also that in the same way they had originally subjects in a bottom compartment, since cut off. As Byzantine art progressed we find frequently an evolution of the same type; for example, among ivories, on the fine and well-known plaque of the twelfth century of the Bastard collection, or as in the Madonna of the crypt of Sta. Lucia, at Brindisi; essentially the same, with accretions in accordance with the evolution of Byzantine feeling. Now Didron contested the authenticity of these covers, and Molinier agrees with him, though I think he recognises the Saulieu, or St. Andoche diptych. I have included on this slide the St. Mennas pyx, for reasons I have before alluded to.

I show also a portion of the frieze of the door at Dana, in Syria, with the peacocks, from which Molinier finds an almost exact copy in the plaque we are noticing. Dismissing, as I think we ought to do, the idea that the Berlin plaques are coeval with the chair, may we not imagine that even if made in very much later times, all sorts of circumstances besides intention to deceive may account for their origin. As to the Paris book-covers, they are evidently by an inferior artist copying, to the best of his ability, from some original now lost to us. Strzygowski and Diehl see in them a Syrian or Alexandrian school of the first half of the sixth century. I shall return to them again, presently, if there is time.

I should like to emphasise very strongly the connection between the Berlin book-cover and the Virgin of the ambon of Salonica. But although the latter may be of the fifth, or perhaps of the sixth, century I still refuse to ascribe so high antiquity to the Berlin plaque.

I now put before you the famous Brescia casket as a most beautiful example of Italian workmanship, ascribed to the fifth or sixth century. Here are the front plaques of the casket. So covered are they with a multiplicity of detail that they will suffice as an illustration of the whole. Observe the decorative treatment, the fine balance and harmony, the placing and grouping of the little flock of sheep, the management of the curtains, and the scroll in the central scene, the arrangement and movement of the figures beneath. These are the keynotes of the charm which so

many works of the kind are capable of giving to those who rightly look at them. For the rest, the delicacy of the workmanship is remarkable, and singularly appropriate also is the material which is used. Still, I would ask is every part of the casket the work of the same artist? I am inclined to think that most of the border-pieces are by another hand. Compare these border-pieces with the panels of a smaller casket in the British Museum the suggestion is very strong indeed that there is a connection between them, and they are conceived in the same spirit as the figures and edging border of the sarcophagus of St. Appollinare in Classe. Stuhlfauth has an elaborate and long-drawn-out theory in relation to this casket of what he calls a *Zahlengesetz* or law of numbers. From this supposed law he draws certain deductions based on the number of times or multiples of times this or that typical figure is represented. Personally, I am reminded of the ingenious Shakespeare-Bacon cryptograms, as confusing as a nightmare and as of little practical value.

FIG. 10.

PANEL OF THE LORSCH BOOK-COVERS (SOUTH KENSINGTON).

The important pair of book-covers, of which one panel is at South Kensington the other in the Library at the Vatican, have given rise to so much discussion, that to attempt to follow

it in detail would absorb more time than we can afford. I may, I hope, refer to them as the Lorsch book-covers without offending those who may consider that they were not originally related. To begin with Westwood, if I understand aright the note in his appendix, he adheres to his early opinion that they are Italian work of the sixth to eighth century, and that he knows no Carlovingian illumination or carving which can be compared with them. Strzygowski is also for the Italian origin under strong Byzantine influence, and ascribes them to Milan. Molinier considers the South Kensington half a pendant of the other made in Germany in Ottonian times, of Byzantine formulæ, but without the soul

FIG. 11.

PART OF LEAF OF THE CARRAND DIPTYCH.

of that art. This is a fine-drawn distinction indeed, but I do not like to accept Molinier's almost contemptuous analysis of this South Kensington panel. There are slight differences, it is true, in the architecture, drapery, and treatment of the features of the principal figures, and it would seem not unlikely that the one is imitated from the other. Parts in each are finer in style, better in technical skill than in the other. I think that two scupltors worked both plaques conjointly. That the artist, whoever he was, drew his inspiration from various sources and models is evident. And I see no reason why they may not be the work of a Greek sculptor-monk in the very abbey for which they were made, perhaps a hundred years after its foundation in A.D. 763, nor that the ninth century is too late a date. The chronicles mention that Abbot Salaman, who ruled towards the end of the tenth century, caused three books to be decorated with ivory covers. Were these the panels before us, perhaps as a re-binding? After all, what is the value of the argument that of Carlovingian work one knows nothing so fine? To what style or period are these book-covers tied by ties so strong, and where is their parallel to be found? The question of their originality, with our present knowledge, defies settlement one way or the other. I have put together with them on one slide the Paris and the Etschmiadzin book-covers. You will remark the medallions upheld by angels in the style which is so frequent, with variations, of the *imago clypeata*. It is not difficult to trace them through a series of adaptations or evolu-

FIG. 12.

LEAF OF DIPTYCH.—KENSINGTON MUSEUM.

tions back to classical times, to the funeral monuments with a bust of the deceased. We shall find in these all the elements, afterwards elaborated till a settled type was reached. Perhaps this type on the Lorsch covers came through the mosaics of San Vitale.

Hardly less interesting is the St. Paul diptych of the Carrand collection, now at Florence, of which this is one-half. Ascrptions vary from Kraus and others in the fourth to Molinier and Westwood in the fifth or sixth century. Can we doubt the direct classical influence by which also so many of the sarcophagi were inspired? Much controvery has arisen. Marriott, in his "Testimony of the Catacombs," is extremely strong on the question which regards the relative positions of honour occupied by St. Peter and St. Paul. In this direction I should like to draw your attention to the interesting relationship—not hitherto noticed, I think—between

this scene and the very similar one on the beautifully worked small leaf of diptych of the ninth century in the Kensington Museum. We

FIG. 13.

THE BODLEIAN BOOK-COVER.

have the same faldstool, the same dolphin arms, the same figures, but it is St. Peter, who is seated, and St. Paul—if it be St. Paul—who writes to his dictation. Now the separation of the Greek and Latin churches was in A.D. 729. Would a Byzantine Greek artist of the ninth century have given St. Peter this distinguished position? It seems to me to be worth while to compare the head of St. Peter with the antique gem seal [Towneley gem in British Museum] which is also illustrated on

the slide. It has evidently been copied from a seal of this kind, many of which are found on Carlovingian charters. Earlier seals of the Merovingian dynasty are invariably rude and barbarously made, but Charlemagne and his successors were fond of using antique gems for their signets. A label lately added to this plaque in the Museum, classes it with the St. Mark series in the Museo Archæologico at Milan. I am not satisfied that it is meant for St. Mark or that it belongs to that series. The type may be admitted, but we need not be absolutely bound by it. But I am not now considering the Milan series, nor the subjects on ivories. In any case, I am convinced that the Kensington plaque has uothing to do with Alexandria or Constantinople, that the carver copied from various sources, that his prototype was the Carrand St. Paul diptych, and that this piece belongs to the very end of the periods we are considering.

Very much connected with the general theory which I have been attempting to elucidate, with the persistence of traditions and styles, and with the absence of distinct national elements sufficient to enable us to determine a critical judgment, either as to date or country of origin is, I think, the well-known book-cover in the Bodleian library of which this is a cast. The arrangement of the subjects—that is, a number of episodes from the Old and New Testaments, in small compartments around a central larger panel —is a system of which we have several examples, and several fragments (to one of which I shall presently refer) suggest that they also formed parts of similar book-covers. I now illustrate with it, for comparative purposes, a leaf of the Genoels-Elderen diptych at Brussels, a plaque in the Berlin Museum, and the central figure of the Vatican half of the Lorsch book-covers. Stuhlfauth was the first, I think, to point out the connection between the Berlin plaque—which, when he wrote, was in a private collection at Amiens—and the Bodleian book-cover. Haseloff afterwards illustrated and described it. That the small panels on the latter are directly taken from the Berlin original, would seem evident. At the same time, these subjects themselves are found treated in a similar manner on the sarcophagi; for instance, the Baptism on a sarcophagus in the Vatican, the cure of the Hemorhoissa on the well-known Lateran sarcophagus. The Bodleian is, I think, in its microscopically-treated subjects, not to be compared to the other for feeling and execution: the pose and movement and expression on the faces of the latter are admirable. There are three panels on this fragment. The Bodleian has ten small and two large compartments. Where did the artist go for the others? Where is the remainder of the Berlin set? Very remarkable in the drapery of the central figure are the multiplication of folds and the whirlwind-like fluttering of Anglo-Saxon iconographic methods: in the Brussels

FIG. 14.

LEAF OF THE GENOELS-ELDEREN DIPTYCH.

panel the same Anglo-Saxon character, and the borders with a diagonal key-pattern. Mr. Romilly Allen, in his "Celtic Art," describes this pattern as a variation of the Greek fret introduced by the Christian Celts. Certainly it is distinctly national. The cross carried over the shoulders is unusual, but a somewhat similar way of carrying it is found in the mosaics of St. Mark's, Venice. Molinier traces this central figure to the central figure of the Vatican book-cover. Whether it is not rather stretching a point to call it, as he does, "une copie presque textuelle" you can judg

here for yourselves. He considers the Brussels covers to be of Byzantine origin—an imitation proceeding indirectly through the Bodleian plaque, and certainly made in a British abbey. Stuhlfauth is so appalled at certain difficulties which he creates that he gives up the problem in despair, and finally ventures on the bold opinion—unsupported and even unhinted at, so far as I know, by anyone else—that the Bodleian book-cover is a modern forgery. I hardly think the Bodleian authorities are likely to worry themselves unduly about this judgment. Whether the work is Italian or Anglo-Saxon of the ninth or tenth century it is impossible to determine. I am inclined to allow just a little weight to its *état civil*, and the circumstance that it finds itself in this country. It is again an example of the persistence of favourite types and ornaments, and, if not of native British make, of the many sources to which the artist went for his models. Mr. Maskell characterised it as a very superb piece, and in date not later than the tenth century. It may well be, I think, a hundred years earlier. Finally, I may remind you of the pagan origin of these representations of

Fig. 15.

Panel of the Lorsch Book-cover (Vatican).

Our Lord and their connection with the god Horus, as pointed out by Dom Leclercq.

I will refer here very briefly to the curious bone plaque in the Museum at Kensington, which I consider of Irish workmanship possibly made abroad. With all its exaggeration, and perhaps grotesqueness, there is great artistic power in it. The artist knew what he was about. I place alongside it the other leaf of the Genoels-Elderen diptych.

FIG. 16.

LEAF OF THE GENOELS-ELDEREN DIPTYCH.

I have left myself no time to refer, as I wished to do, to the famous half of a diptych with an archangel, in the British Museum, and some other plaques—such as those of the Rouen "Livre d'ivoire," and the very beautiful Anunciation plaque in the Trivulzio collection, which have possible relations with it. Personally, I should like to ascribe the British Museum archangel to Greek art of a time very near that of Constantine. The angel's wings may be a difficulty, but I see no reason why the only possible period should be as late as the time of Justinian. Wiith regard to the Trivulzio Anunciation, I will content myself for the moment with breathing the word Syria in connection with it.

I should like to say a few words about the interesting Alcester tau lately added to the British Museum. With all due respect to the Museum authorities, I think it is stretching a point to assume that it is a piece of truly English craftsmanship. We have no evidence that ivory carving was practised in England. It is true there are the Northumbrian casket and the Godwyn seal, but the one is of quite a different character and the other is as likely as not to have been ordered abroad. The tau, wherever made, is, indubitably Oriental in style, and, I am inclined to think, Rhenish-Byzantine or perhaps French. Compare the figure in the vesica with the figure, in a similar vesica, of like gait and with like cross, in the walrus plaque of the Ascension in the Kensington Museum. If made abroad, the sculptor would hardly have had time to become acquainted with the Ethelwold Benedictional, but if there are the resemblances which Mr. Read finds to the foliage in that MS. the sculptor would have had Anglo-Saxon MSS. to which to refer and the miniatures of the Benedictional itself—if not by a Greek artist — followed Byzantine traditions. The interlaced work is of course of too universal a character upon which to found any suggestions. It may not be easy to trace perhaps the flower, but at least there is nothing national about it. Something of the kind, though more like a sunflower, may be seen in the upper corner of the Vatican book-cover. Besides this I hardly imagine that taus were used in the diocese of Winchester in the eleventh century. I should like to be shown any miniatures of the period representing bishops or abbots carrying them. It is true there are four or five examples of the form itself, as emblems or ornaments on sculptured stones in England and Scotland of an earlier date. To this day, as we know, they have persisted in the East. I should think this tau—if it be a tau, or perhaps a bishop's or abbot's crutch, or for use in choir —found its way to England as an object of curiosity.

In spite of endeavours to condense as much as possible, I have, I am afraid, risked wearying you by spinning out my discourse to inordinate length. We have been occupied with times beginning with those when Christian art, after Justinian, began to show signs of decay, through the iconoclastic paralysis which it underwent in the East under Leo the Isaurian (717-741), and its subsequent period of stagna-

tion, and up to—and perhaps past—the revival and zenith of Byzantine art in the days of Irene and Basil I. (801-867). A new style seems to come in in our ivories at the end of the ninth and in the tenth century: we see it, for example, in the numerous Crucifixion plaques. Certainly in these there is originality or less copying. What I have endeavoured to point out has been the persistence in our ivories of very early Christian traditions, derived originally from pagan sources, that there is no evidence of schools, that there is throughout comparatively little originality or perfection of execution, that styles are almost reduced to one, and that it is not unreasonable to assume that they are in great part the productions—if I may use the term—of the Scriptoria of the monasteries. Again, we must consider the general state of Europe in those days: the inroads of the barbarians through which various spoils came to the West as models for the native artists: or, for instance, in the ninth century, the presents from the ambassadors of the Khalif to Charlemagne. We see also attempts to translate the illustrations of MSS., such as the Utrecht Psalter, into sculpture. It would seem almost as if the ivory carver were destitute of imagination or mistrusted his own power of originality. The originality of the miniatures themselves, or whether both the illuminator and the sculptor may have gone to the same source for inspiration is another matter. The amateurishness of such things as, for instance, the Lupicinus book-covers asserts itself. Is it reasonable to dignify attempts of this kind by assigning to them a school—of Ravenna, or anywhere else, except the cell of an inmate of a monastery? Perhaps hardly ever in the whole of its history has ivory carving been a profession by itself; though taken up as a distraction now and again by great sculptors as it is to-day, or often by dilettanti of various degrees of talent. Even in the cases of the Museum Archangel or the *meleretense* diptych—to put the matter strongly—however much we may admire the latter, and look at it as a thing to dream about, and though we may admit the high talent of the particular sculptor, we may yet hold that they are not truly original work but rather adaptations (admirable, indeed) from the numberless models of classic art of the finest period which still existed in Italy or Greece or in the newly-founded capital of the Byzantine Empire. And when we come to so many examples in the days of decadence, what is the style, after all? We can distinguish style in the rudest and most barbaric art, but often here there is no style but dull, stupid copying, admitting the devotion and enthusiasm of the untutored sculptor who did his best for the glory of God and embellishment of his monastery. May we not see in many of these things strong indications of what was very likely to happen within the numerous monasteries? That is to say, certain of the community artistically inclined who, without any training, and influenced by their own enthusiasm and genius—such as it was—set themselves to work to supply the needs of the library or the oratory. We can imagine their exhibiting their productions with pride to the wondering eyes and admiration of their brethren. They worked by rule of thumb, endeavouring slavishly to copy, line by line, and not always successfully. To this day the Greek and Russian monks, and even the villagers, work in the same way, and for hundreds of years the types have not varied with them. Even in the thirteenth and fourteenth centuries it seems clear that there were geniuses from time to time who originated certain type-pieces, which were copied over and over again with more or less success. We cannot identify those who originated the masterpieces; we cannot always distinguish with certainty even the nationalities, but we can without much difficulty say which are but copies. Some day, I venture to hope, these will be distinguished also in our great museums.

There is plenty to say with regard to the immigration of Greek monks, for which there is not now time. Briefly, they were numerous in Sicily and Calabria, which were a part of the Eastern Empire. The iconoclastic persecution drove them over, and the invasions of Syria by the Turk. And I think it is certain that in many cases their art was, in spirit at least, subdued by or subordinated to Latin influences. I shall not now attempt to follow their dispersal and settlements in various parts of the Empire, nor do more than indicate, as I have done, the influence of the Anglo-Saxon and Irish missionaries and monks.

As we approach the tenth century, we are arriving at a second period of Byzantine influence. It is not a new and original system, but it is at least an original system of adaptation more easily recognisable to which it is more easy to assign definite limits until it crosses the almost invisible border line and merges into pure Gothic. Before this transition is made, there still remains something to be said

of the interesting Rhenish ivories of the eleventh and twelfth centuries.

I am conscious that in endeavouring to compress a great deal into a short space of time, I must have made many lapses, and perhaps laid myself open to misconstruction. It is difficult to avoid the disappointing conclusion that despite the mass of literature in the last decade or two, we are hardly more advanced than we were thirty years ago. We know no new facts, hardly a new example of importance has turned up. It is not indeed too much to say that apart from the interest of attempting to elucidate problems as puzzling as a cryptogram, the collector or historian whose knowledge of the literature stops short a quarter of a century ago, can hardly be said to have lost very much if he is not up to date. I do not know if I may flatter myself that I have succeeded in interesting you: very sadly I am free to confess that my contribution to positive knowledge can be but slight, and that it is hardly anything more than suggestive. But if I am not an efficient pioneer, I feel sure, at least, that there is need for reconstruction. I think that considering the divergences of opinion the labels in museums ought to recognise these divergences instead of being rigidly dogmatic.

SEAMEN IN NEW YORK.

For some years past the seaman's branch of the Protestant Episcopal Church Missionary Society in New York has been doing much to protect seamen temporarily in the port, and to provide them with entertainment in addition to religious care and instruction. The total number of the crews of British vessels visiting New York in 1905 was 129,070, and the number of seamen engaged and discharged was 20,741, the money paid directly to seamen on discharge amounting to £76,800, and £17,600 was deposited by 1,297 seamen for temporary safe keeping with the society. These figures show a considerable advance on those of former years, both as regards the amount deposited and the number of men who avail themselves of the facilities offered by the society, and as in many instances the balance of wages due to seamen on their discharge is but small, the proportion of depositors among those having appreciable sums coming to them is larger than would appear at first sight. The society has been largely influential in rendering the worse class of seamen's boarding houses unprofitable, and they are now raising subscriptions in order to erect a Seamen's Institute, which Consul-General Sir Percy Sanderson, from whose report (3,665, Annual Series) these particulars are taken, says will cost approximately £110,000. The building will be from 8 to 10 storeys high, and will contain a free shipping bureau where masters will be able to find crews without the intervention of shipping masters, and seamen will find employment without the services of intermediaries. In addition to club rooms, there will be sleeping apartments for 250 to 300 seamen, as well as for officers, a large meeting hall, and a department for the deposit of seamen's wages. It is estimated that the institute will take two years to build. The scheme is receiving considerable support, and the advantages to owners and all concerned with shipping is so great that the amount required, though large, will probably be raised without difficulty.

GERMAN COMMERCIAL AND TECHNICAL EXPERTS.

The Chamber of Commerce for the Sonneberg district, in its annual report, devotes considerable attention to the subject of commercial and technical experts as *attachés* to consulates. It considers German Chambers of Commerce in foreign countries useful in promoting the foreign and home industries in Germany, differing in this opinion from the Imperial Chancellor, and approves of the methods of the Government of attaching to important consulates, commercial and technical experts, who are to closely study the economic and trade conditions of the countries to which they are sent, and report thereon to the home Government, which will communicate the information to German manufacturers, merchants and exporters. The report says that it is urgently desired that this institution (of experts as *attachés*) be so formed as to fully respond to the requirements of German trade interests in the world's markets, and to satisfy the constantly increasing demand for information. For the accomplishment of this, it is necessary, in the first place, to appoint such experts at all foreign points of commercial importance to Germany, more particularly at its principal consulates. The *attachés* must keep in constant touch with manufacturing and commercial circles of Germany which trade with the respective foreign countries. It is also urged, that it would be very desirable, that these expert *attachés* should, from time to time, visit in person the industrial districts of the home country, and discuss all matters pertaining to mutual trade relations between Germany and foreign countries. The report expresses the satisfaction of the Chamber that the Imperial Government has notified its readiness to comply with this desire, and already the German commercial *attaché* for Argentina has visited Sonneberg, and consulted with exporting circles interested in Argentine trade. Another point on which great stress is laid is the importance of these expert *attachés* not too frequently changing their posts, because a continued stay will enable them to become fully conversant with the economic conditions of their spheres of activity, whereby they will become more proficient and their services more beneficial to German trade.

HOME INDUSTRIES.

The Shipbuilding Crisis on the Clyde.—The Clyde shipyard workers continue on strike under conditions which are very exceptional. They went out because the employers refused an advance of wages. If this demand had been made last year, when the yards were working to their utmost capacity, and large orders were on hand, it would have been difficult to resist. Delayed until the autumn of 1906, when the yards are emptying, and there are few new orders, it is hopeless. Many men would have been paid off if there had been no strike. During last month the number of vessels launched in Scotland was 41, with a measurement of 57,990 tons, and of these 26 vessels, of 47,585 tons, were launched within the strike area. The Clyde figures are 10,300 tons less than for the corresponding month of last year, but they are higher than any other October month except 1905 and 1898. The total output of Scotland for the ten months ended with October has been 359 vessels, of 557,600 tons, or 100,000 tons more than for the ten months of last year, but owing to the strike the total for 1906 is not expected to exceed, as at one time it seemed likely to do, the output of 1905. But whilst the shipbuilding record of the year in Scotland has been so far a record one, and the output of the Clyde yards alone for the ten months shows an increase of some 92,000 tons as compared with 1905, itself a record year, it is all past working in so far as the shipyard ironworkers are concerned, and the outlook is anything but encouraging. Several yards have only one or two vessels each on the berths, and the fresh orders booked during October were quite trifling. Whatever may be said as to the past, probabilities point to considerable slackness during the coming months. At the instance of the Provost of Glasgow representatives of the shipbuilding employers met delegates of the men a few days ago to discuss the situation, but neither side was in the temper to concede. The employers argued that all the influences point to lower rather than higher wages, but expressed their willingness to undertake that the present rate of wages should be maintained for at least four months, say until March next, by which time it would be seen if the shipbuilding trade has improved, or is likely to improve. Unfortunately the delegates of the men at the Conference did not see their way to accept. Perhaps they were without powers to do so, and their refusal only means that they must consult the Executive Council of their Society. Anyway it is understood that the employers suggestion is being discussed among the men in their branches, and no doubt it is being considered by the Council. At the time of this note being written it is thought not unlikely that the men may ask for another Conference with the object of coming to terms. It is most earnestly to be hoped that agreement will be arrived at, and soon. Already the strike has entailed much suffering and loss, which will be greatly intensified if the Society of Boiler-makers and Iron and Steel Shipbuilders decide that it shall not be carried on any longer at their expense.

Iron and Steel.—It is a significant fact that notwithstanding the Clyde strike, the prices of finished iron and steel have not suffered even in Scotland, where yards producing half a million of tons of shipping per annum are closed as far as ironworking is concerned. At the present time Scotland makes about 1,250,000 tons of steel per annum, and the Scotch shipyards take about 350,000 tons of steel, plates, angles, &c. The rest of the product goes in structural and other material, for which the export demand is now very large. It is because of the large orders received by the steel makers of Scotland from abroad since the strike began that the suspension of orders of local shipbuilders has been received with comparative indifference. But for the foreign demand the steel market must have fallen away under the shipbuilding crisis, whereas, in fact, it has not done so. The iron trade is even more indebted to the large export demand. The demand for Scotch pig-iron continues, and it has been estimated that New York has recently bought close upon 10,000 tons. Prompt despatch is insisted upon, and last week the unusual step of chartering a steamer to load a cargo from the Clyde to New York was taken, the regular carriers having raised their rates to a point which is said to be almost prohibitive to business. Nor is the demand confined to the Eastern States of America. Inquiries are being received in bulk from San Francisco, South America, the Far East, and the Continent, and no less than 2,600 tons were sent to Canada last week, whilst the Australian Colonies were free buyers. The German and American demand for foundry iron has sent up Cleveland warrants to 58s. 6d. Notwithstanding domestic influences that without this demand would have put the warrant market down to a low level, Germany is now buying No. 3 foundry iron, and large American orders have been received for foundry iron for shipment from the Tees as well as the Clyde. It was believed that Germany would not buy Middlesborough warrant iron because it is not adaptable for conversion into basic steel, and that America would not come here for foundry iron because if she wanted that quality more of her furnaces would be turned on to it. But these forecasts underrated the activity in both Germany and the United States. The blast furnaces of the latter country are now turning out at the rate of 2,000,000 tons per month of pig iron of different grades, but huge as is this output it does not meet the demand.

Coal.—According to the annual returns, the quantity of coal raised in the United Kingdom in 1905 was 236,125,936 tons, the largest on record, and exceeding the output of 1904 by some 3,700,000 tons, although its value was less by £1,819,251, the average price of coal at the pit's mouth having fallen from 7s. 2·58d. per ton to 6s. 11·38d. The quantity

of coal exported in 1905 was 47,476,707 tons, 2,287,792 tons were sent abroad as coke or patent fuel, and 17,396,146 tons were shipped for the use of British and foreign steamers. There is every reason to believe that the production and exports this year will show a further considerable increase. So far as the exports are concerned, the nine months ended September show immense expansion. The figures for the nine months are as below:—

	1905. Tons.		1906. Tons.
Coal	35,308,656	..	41,229,705
Coal	522,496	..	570,713
Patent fuel ..	848,603	..	1,072,435
Total exports	36,679,755		42,872,853
Bunker coal ..	13,071,267		13,845,545

The increase in the supply of bunker coal is comparatively small, and for September it was nearly 60,000 tons less than for the corresponding month of last year, the explanation being that the export tax on coal was timed to cease on November 1. Shipments during October were much curtailed for the same reason, but the removal of the tax may be expected to give a considerable impetus to exports in this month and next, so that the figures for the year promise to be considerably in excess of those of last year. The activity of the export trade is of course largely due to the demand from Germany consequent upon the strike of German miners last year, and the present great industrial activity of that country. With reserves exhausted, and consumption increasing, Germany has had to come to the United Kingdom to supply not only some of her own wants, but some of her foreign customers. Our home consumption has not increased, nor is it likely to do if the shipbuilding crisis, with its probable effect on the home iron and steel industries, continues. The removal of the shilling tax may still further stimulate exports, and altogether our home demand is not likely to increase beyond normal winter requirements —the indications rather point the other way —the foreign demand is already having its effect upon prices. Welsh steam coal has advanced to 17s., although at the moment the quotation is lower; Newcastle best Northumbrian steam coal is up to 12s., and in the Midlands and Lancashire prices are all higher. Even in Scotland, which has less to do with foreign business, prices are now from 1s. to 2s. per ton higher than those current a year ago. It would seem, therefore, that with the continuance of the foreign demand that may be expected, we shall see a still higher range of prices.

Railway Fares and Rents.—An argument that has appealed to many who do not think things out in connection with the recent revision of the Underground Railway rates is that the raising of fares is a breach of faith, almost a breach of contract on the part of the company, and is the cause of serious loss to the householders in the affected districts. The contention will not bear examination, so far as tenants' loss is concerned, and the other point is not discussed here. As the *Statist* of November 3rd points out, in an interesting article, it would hardly be too much to say that the railway fare to and from a district is the least of the questions affecting the rental value of houses. Assume that in a district, within convenient reach of the metropolis, large blocks of houses and tenements suitable for the working classes have been erected at a time when the return fare amounts to 2s. per week. Assume further that the railway company serving the district has been required to issue tickets for workmen at 6d. a week, or perhaps for nothing at all. Would the occupants of the houses, therefore, be 1s. 6d. or 2s. better off? They would not, except in very exceptional circumstances. The saving in the fare would generally be added to the rent. The owners of the houses might, and probably would, benefit, but the tenants would be no gainers. Paying little, or nothing, for fare, he would pay more for rent. And if the converse is taken, if instead of the tenant having to pay 1s. 6d. or 2s. less for railway fare he had to pay 1s. 6d. or 2s. more, he would be no loser, any way after there had been time for the inevitable readjustment. In this case rents would fall and the landlord would be the loser. The tenant would neither lose nor gain so far as rent is concerned. The *Statist* refers to the case of Shepherd's-bush. This district is exceptionally well served by good and cheap means of communication. The opening of the Tube was a great advantage to it in this respect. Have its inhabitants benefited by the cheaper means of transit to their business? In one sense, of course, they have, but not in reduction of expenses. If they pay less for fares they pay more to the landlord, rental values having greatly increased in the neighbourhood. The truth is railway fares are only one of several factors which determine the rents obtainable for houses and tenements. Available land, close proximity to a station, or tramway route, the class of houses in the neighbourhood, the extravagance or prudence displayed in the management of municipal affairs; these are factors which affect rents quite as much as railway fares, although, of course, facilities for travelling exercise a marked influence in making a district popular.

GENERAL NOTES.

Cotton in Chinde.—Reporting on the trade of Chinde (Cd. 2682), Mr. Vice-Consul Hewitt-Fletcher says that the British company growing cotton on the Shiré, near Chirono, has done well. The crop in 1905 was good, and the cotton fetched Egyptian cotton prices, viz., 7½d. to 8½d. per lb. on the Liverpool market. The gross yield was diminished owing

to inefficient labour supply, which made it necessary to abandon a part of the planted acreage during the wet season, and also prevented part of the remaining acreage being sufficiently cultivated. However, among the plots which received the most attention an average of 350 lbs. an acre was attained. A thorough cultivation of a smaller area produces better financial results than superficial cultivation of a comparatively large one. The company has for the 1906 season restricted the area under cotton, in accordance with its labour supply actually available, and has planted 1,000 acres of cotton, together with an equal area of food stuffs. It is estimated that one man can keep clean one acre of cotton during the growing season, namely January to April, and that one extra man per acre is required for various services, such as growing food for the labourers, keeping the plantation in order, &c. Should the labour supply not improve when the Shiré Highlands Railway is completed—which will probably be in some eighteen months time—there is a possibility of resort to Indian coolie labour. The labour difficulty, says the Vice-Consul, is the only hindrance to the cotton industry in the Shiré valley, where the soil and climate are exceptionally well suited to cotton growing.

British North Borneo.—Mr. Consul-Agent Darby's report on the trade of British North Borneo (Cd. 2682) describes a very stagnant and unsatisfactory state of affairs. The amount of direct trade between it and the United Kingdom is very small, the imports consisting chiefly of wines and spirits, agricultural implements, and various kinds of machinery. There is no direct communication between North Borneo and Europe, and the consequent high rates of freight tend to discourage trade. There is an adequate steamer service from Singapore and Hongkong, but the former is exclusively in the hands of the Germans, and the latter is divided between them (the North German Lloyd) and the Indo-Chinese Steam Navigation Company. The planting industries consist almost exclusively of tobacco plantations and rubber estates. The former represent estates (owned by three companies) which have been under cultivation for several years, and are the survival of some twenty concerns that have started from time to time to cultivate wrapper tobacco. The industry shows no sign of expansion, on the contrary two estates were closed in 1905. With one exception the rubber estates have all been recently opened, and are still under development. In order to stimulate public interest in these ventures the Chartered Company pay the proprietors an annual dividend of 4 per cent. while the estates are in course of development. Cocoanuts are being more freely planted than formerly, and it is expected that in a few years the output of nuts will be considerable. The manganese deposits are now being worked. The present stagnation is attributed by the Consular-Agent to the difficulties caused by change of currency, the lack of local capital, and the condition of trade in South China.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 12...East India Association, Caxton-hall, S.W., 4 p.m. Mr. Theodore Morison, "The Association of Indians with the Government of India."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. L. A. Wallace, "North Eastern Rhodesia"

University Extension Guild, University of London, South Kensington, S.W., 8 p.m. Mr. Banister Fletcher, "Greek Temples of the Doric order."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Alfred Austin, "The Relation of Literature to Politics."

Tuesday, Nov. 13...Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. 1. Mr. W. Pollard Digby, "Some Investigations Relative to the Depreciation of Electrolytically-produced Solutions of Sodium Hypochlorite." 2. Mr. Charles V. Biggs, "The Hermite Electrolytic Process at Poplar." 3. Dr. Alex. C. C. Cumming, "The Electrochemistry of Lead."

United Service Institution, Whitehall, S.W., 3 p.m. Major-General Sir A. B. Tulloch, "The Argentine Republic and its Neighbours."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Charles Frewen Jenkin, "Single-phase Electric Traction."

Photographic, 66, Russell-square, W.C., 8 p.m. 1. Presidential Address. 2. Mr. W. H. Bennett, paper on his Exhibition of Photographs.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Prof. R. Burckhardt, "On the Embryo of the Okapi." 2. Mr. F. F. Laidlaw, "Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904-05. Report on the Turbellaria" 3. Mr. Oldfield Thomas, "List of further Collections of Mammals from Western Australia, including a series from Bernier Island, obtained for Mr. W. E. Balston. With Field-notes by the Collector, Mr. G. C. Shortridge." 4. Messrs. J. Cosmo Melvill and Robert Standen, "The Mollusca of the Persian Gulf, Gulf of Oman, and Arabian Sea, as evidenced mainly through the Collections of Mr. F. W. Townsend, 1893-1905; with Descriptions of new Species." (Part II. Pelecypoadr)

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. Richard Jebb, "Notes on Imperial Organisation."

Wednesday, Nov. 14...Japan Society, 20, Hanover-square, W., 8½ p.m. The Right Hon. Lord Redesdale, "A Tale of Old and New Japan."

Thursday, Nov. 15...Linnean, Burlington-house, W., 8 p.m. Mr. Horace W. Monckton, "Recent Researches in Norway."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. F. E. E. Lamplough, "The Determination of the Rate of Chemical Change by Measurement of Gases Evolved." 2. Mr. S. Ruhemann, "Xanthoxalanil and its Analogues."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Hubert von Herkomer, "Artistic Possibilities of the Machine."

United Service Institution, Whitehall, S.W., 3 p.m. Colonel J. D. Fullerton, "Recent Progress in Aerial Navigation."

Friday, Nov. 16...Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "The Architectural Treatment of Windows."

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Mr. Thomas Clarkson, "Steam as a Motive Power for Public Service Vehicles."

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FRIDAY, NOVEMBER 16, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One-hundred-and-Fifty-Third Session will be held on Wednesday Evening, the 21st of November, when an Address will be delivered by Sir STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council. The Chair will be taken at 8 o'clock:—

Previous to Christmas there will be five Ordinary Meetings, one meeting of the Indian Section, one of the Colonial Section, and one of the Applied Art Section.

The following arrangements have been made:—

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

NOVEMBER 28.—"Patent Law Reform." By JOHN WILLIAM GORDON. SIR WILLIAM H. PREECE, K.C.B., F.R.S., will preside.

DECEMBER 5.—"The Metric System." By COLONEL SIR CHARLES M. WATSON, K.C.M.G., C.B. SIR DAVID GILL, K.C.B., F.R.S., will preside.

DECEMBER 12.—"Fruit Growing and the Protection of Birds." By CECIL H. HOOPER, Member of the Council of the National Fruit-Growers' Association.

DECEMBER 19.—"Modern Developments of Flour-Milling." By ALBERT E. HUMPHRIES, President of the Incorporated Association of British and Irish Millers.

Papers to be read after Christmas:—

"The Straits of Panama." By PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company.

"The Principles and Practice of Insurance, and their modern Developments." By THOMAS EMLEY YOUNG, B.A., Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association.

"Smoke Prevention in Factories." By JOHN B. C. KERSHAW, F.I.C.

"The Underground Water Supply of the Thames Basin." By CLAYTON BEADLE.

"Engraving and Photogravure." By. J. CRAIG ANNAN.

"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc.

"Cold Storage and Food Supply." By HAL WILLIAMS.

"Modern Typewriters and Accessories." By ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

DECEMBER 4.—"The Cape to Cairo Railway." By THE HON. SIR LEWIS MICHELL, late Member of the Cape Ministry.

January 15, March 5, April 23.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

DECEMBER 13.—"The Indian Mohammedans: their Past, Present, and Future." By A. YUSUF ALI, M.A., LL.M. (Cantab.), I.C.S.

January 24, February 14, March 14, May 2, 30.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

DECEMBER 18.—"Basket-Making." By THOMAS OKEY.

January 29, February 19, March 19, April 30, May 28.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

A. D. HALL, M.A., Director of Lawes Agricultural Trust, "Artificial Fertilisers: their Nature and Functions." Five Lectures.

LECTURE I.—NOVEMBER 19.—*The Nutrition of the Plant.*

LECTURE II.—NOVEMBER 26.—*The Fixation of Nitrogen.*

LECTURE III.—DECEMBER 3.—*Nitrogenous Fertilisers.*

LECTURE IV.—DECEMBER 10.—*Phosphatic Fertilisers.*

LECTURE V.—DECEMBER 17.—*Potassic Fertilisers. Consumption of Fertilisers.*

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

January 28; February 4, 11.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

JUVENILE LECTURES.

Two Lectures suitable for a Juvenile audience will be delivered on Wednesday afternoons, January 2 and 9, 1907, at 5 o'clock.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Tuesday afternoon, 13th inst. Present: Lewis Foreman Day, F.S.A., in the chair; Cyril Davenport, F.S.A., Gerald C. Horsley, Thomas Graham Jackson, R.A., Halsey Ricardo, Hugh Stannus, F.R.I.B.A., H. H. Statham, F.R.I.B.A., Prof. John Millar Thomson, LL.D., F.R.S., with Sir Henry Trueman Wood (Secretary of the Society), and Henry B. Wheatley (Secretary of the Section).

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

IVORY, IN COMMERCE AND IN THE ARTS.

By ALFRED MASKELL, F.S.A.

Lecture III.—Delivered May 7th, 1906.

THE WORKING, APPLICATION, AND USES OF IVORY.

In the first lecture of this course I explained the structure and characteristics of ivory and traced the sources of its production from the animal in its wild state up to its arrival in the two great markets of the world. I had before me for exhibition a number of specimens of ivory of all descriptions in various stages of its growth and also different kinds of finished and unfinished manufactures. Time limits, however, prevented my bringing these examples before my audience in the way I had proposed to do. I have, therefore, collected some of them again and will now return briefly to that part of my subject which I intended to have finished with a fortnight ago. We then considered at some length the various species of elephants and also those prehistoric animals so numerous at one period of our earth's history, whose remains still furnish large stores of ivory. They were the hairy mammoth of Siberia, with his immense tusks curling outwards like two great scythes from which the mammoth ivory is derived, and other, now extinct, ivory-producing mammals. We next passed in review the two great existing species, that is to say the Asiatic or Indian elephant and the African. Of the former the Cingalese variety — for some reason not satisfactorily explained — is seldom provided with tusks. Besides the elephant the ivory produced by some other animals is of commercial value and use. These are, first, the hippopotamus, or sea-horse as it is called in the trade, with which you are familiar at the Zoological-gardens. He has two immense canine teeth or tusks; six others, which are curved, in the upper jaw; and six, straight, in the lower. The ivory is extremely dense and hard and covered with a thick layer of enamel as hard as porcelain—so hard as to strike fire with steel and consequently not liked by the turner. I was able to exhibit a very fine specimen of a skull showing all the tusks and teeth. Then there are various species of wild boar—notably the warthog of South Africa—which produce quantities of ivory like material fit for small objects. But most of the boars' tusks come from India. And amongst marine animals we have the sperm-whale with its immense jaws full of curious teeth, of which I will show you a specimen presently, and the walrus whose long tusks projecting downwards are, in some respects, a fine quality of ivory, and were at one time extensively used. Then there is the curious horn, or defence, of the narwhal—a fine specimen of which I exhibit—reaching sometimes a length of eight to ten feet, but more an object of curiosity or decoration than valuable for commercial uses.

Referring to the map of Africa I explained, a fortnight ago, the principal districts where the elephant still abounds, how it has been driven farther and farther towards the Equator, and into the wilds, till there are none now south of the Zambezi, how there are still great herds in the neighbourhoods of the Victoria Nyanza, of the head-streams of the McKenzie river, and under mighty Kilima-njaro, and how, roughly speaking, a line may be drawn in this way

(north to south), or in this way, to the east of which what is known as soft ivory prevails; on the west, the hard variety. I explained to you these different qualities, and also the terms used, derived in many cases from the ports of shipment, such as Bombay, Zanzibar, Malta, and so on. I will now call your attention to the different objects on the table, and add a few remarks to each. These charts, if you care to examine them, will show the fluctuations in value of the different descriptions of ivory, which reached last year a record price of £167 per cwt.—£3,340 a ton—for billiard ball teeth, which, if we could consider it of the same quality and usefulness, would make the British Museum tusk worth about £340 irrespective of its curiosity value.

Very large tusks are difficult to handle for the purposes of demonstration. This moderately-sized specimen will show you the general outside structure and the appearance of the hollow. I have already explained the composition and growth of the ivory itself, and you will see in these sections the characteristic appearance of engine-turning-like markings which is distinctive of true ivory, and how from pressure during growth it is denser in the centre. I show also specimens from various districts in Africa illustrative of the different qualities, especially as regards the *hard* and *soft* descriptions. These are various sections or wedges resulting from the method employed for cutting up a tooth for billiard ball making. It is of course necessary to avoid waste: the cuts are therefore made radiating from an imaginary centre of the curve of the tusk, as shown in the diagram. This is a specimen showing the deterioration from cracking which used at one time to affect the quality of Egyptian ivory more than it does at present owing to improved methods. The soft variety stands the climate better. French Soudan ivory is nearly always *ringy*, and some of the Ambriz variety also. This sample will give you an idea of the meaning of the term. As I said, in my first lecture, the distinctions between hard and soft ivory are difficult to define, and more difficult to explain. Practice and experience will alone enable us to form accurate judgments. The hard is used for fancy brushes and toilet ware, for cutlery handles, and for second qualities of piano keys and billiard balls. It is, as it were, glassy and transparent. Soft contains more moisture, stands differences of climate and temperature better, and does not crack so easily. We may call Zanzibar and Mozambique varieties, soft; Angola and Ambriz all hard. Ambriz was at one time much esteemed. There is comparatively little now. Siam is rarely, if ever soft. Abyssinia has its soft side, but Egypt is practically the only place where both descriptions are largely distributed. Against the Abyssinian variety is its thick bark. Here are labelled specimens of all the above, and several other districts from which ivory principally comes to us.

I discussed at my first lecture, the abnormalities and diseases to which the tusk of the elephant is liable. You will see in this sample what is known as a diseased hollow, here a malformation where the hollow is double, here the thin walls of a stale hollow, here a curious large cavity in the substance of the tooth, known as a "bubble," and here are "beads," osteo-dentine formations resulting from blows or other injuries. These examples of bullets and spear-heads embedded in the tooth, and the resulting osteo-dentine are interesting, especially this large spear-head, lent to me by Messrs. Broadwood. Frequently, as you will notice, no marks are left on the outside of the tusk. This fragment shows the results of hungry rats gnawing the ivory, or sharpening their teeth upon it. The Royal College of Surgeons has kindly lent me a very fine example of a molar tooth. You will notice how beautiful it is in section. I am surprised that it should be of no practical decorative value, and therefore wasted in enormous quantities. The reason, perhaps, is on account of its unequal shrinking. This is the skull and tusks of a young walrus, and this a large sperm-whale tooth, engraved with sketches in the manner sailors are so fond of doing. Finally, this is a kind of ivory from the teeth of the Australian dugong. I have already referred to a gem, as it may be termed, called odontolite, or fossil turquoise, and I endeavoured, but without success, to obtain a specimen in London to show you. This, which resembles it in a way, but which is not the true blue, is African turquoise. Odontolite is mammoth ivory, which by lapse of time, and through surroundings, becomes converted into a substance known as fossil or blue ivory, used occasionally in the manufacture of jewellery. It is obtained from the tusks of antediluvian mammoths buried in the earth for thousands of years, during which time they have been slowly penetrated with the metallic salts which have given them the peculiar colour, allowing them to be used as turquoises.

The applications of ivory for ordinary

domestic purposes are so very numerous that it would be impossible this evening to follow them in detail, or even to enumerate them. Let us take two or three of the most important. Ivory brushes and mirrors require fine pieces, and the former is an important industry of which London is the chief European centre. Hard ivory is mostly used, the soft would be too expensive. Cutlery handles I have already described. Here are various specimens of the different qualities. I need only add, referring to my remarks on the quality of grain, that it is again the hard variety which is almost exclusively employed.

The manufacture of piano keys is of course an important industry. Imagine the vast number of pianos and kindred instruments throughout the world, each requiring a full set of these little thin slabs of the finest possible quality for the best instruments. An inferior kind is of course used for low-priced pianos, and even celluloid or gallalith and other artificial substitutes. This is the form technically known as heads and tails in which the ivory reaches the piano factory. I show specimens of both hard and soft varieties, bleached and unbleached. The thicknesses used in the trade are 1-8th inch for organ keys, 1-12th to 1-16th for best piano, 1-22nd for low priced instruments. The slabs are first matched for grain and colour, then seasoned to prevent warping and shrunk as much as possible, usually in a hot-box. They are then bleached. This process is now a chemical one, formerly, indeed until almost recently, sun-bleaching was used. For some reason or other organists prefer unbleached keys. This is a complete keyboard of a grand piano in its nearly finished state before all the key sections are sawn through. I will break one off to show you. From this condition no doubt comes the term "keyboard." In preparing it the little slabs, or heads and tails, are laid on the board with extreme accuracy in joining. You will observe that the joint is scarcely visible. The glue is Salisbury glue and strong pressure with iron clamps is employed. The keys are then polished with whitening and rubbing as in French polishing, and finally a fine band saw separates each one in its entire length from its neighbour. The fronts are generally made now of celluloid even in the best qualities of instruments. As to the preservation of piano keys it may be as well to say that the keyboard should be kept closed when not in use. We will now turn to one of the most interesting applications of ivory as well as the most difficult—billiard ball making. I cannot pretend with the short time at my disposal to do more than indicate some of the principal points, but they will illustrate in a general way an example of the working of that most fascinating instrument, the turning-lathe.

In billiard ball turning, as in the well-known Chinese puzzle balls and other objects in which a sphere is required, everything depends on the extreme accuracy with which the work is carried out. We must take into account also the shrinking of the ivory, and counteract its efforts to do so during the whole period of its existence. The nature of ivory from this point of view does not materially differ from wood. Both consist of an arrangement of fibres, denser in the centre of a section—perhaps from the pressure of the successively-formed rings or layers—than at the circumference. As the moisture in wood or the gelatinous substances in ivory dry up from atmospheric influences, the substance contracts or shrinks, and necessitates seasoning. This seasoning cannot be entirely accomplished in the cylindrical form as it comes into the ball-maker's hands, from various causes. I have here specimens of the billiard ball in the various stages of its manufacture, and the chucks employed. The first thing to be done is to rough out a sphere about $2\frac{1}{8}$ inches diameter for the English size, which will eventually be $2\frac{1}{16}$, or sometimes, for professional players, a trifle larger, say $\frac{5}{64}$, or $2\frac{1}{16}$ full. One hemisphere is first turned—in this way—this ring being detached with a parting tool. The rings so made form a large export to India, which incidentally I may say is the backbone of the ivory trade, where they are extensively used for bangles. The operation is most interesting and beautiful to watch, as indeed are all the operations of the turning lathe: how in a few seconds, almost noiselessly, with the sharp-cutting and ingeniously-devised tools, the sphere magically forms itself, in the same way as we see a vase grow in clay on a potter's wheel under the worker's hand. The diameter is of course accurately taken, and the subsequent removals taken off in the other directions. The ball is then fixed in a wooden chuck, the half-cylinder reversed, and the operation repeated for the other hemisphere. It is perhaps $\frac{1}{32}$ of an inch larger than it will eventually be when turned practically dead true. It is now left five years to season. It is sometimes stated that billiard balls are turned at intervals of six months four or five times, but this is not the ordinary practice. In selecting the block to be operated upon

it is necessary to bear in mind that the axis of the ball should coincide with the centre or axis of the block of ivory, in order that the density should be properly distributed. If this precaution is not observed the ball would not run true: it would roll unequally, have a bias, in fact, such as is purposely arranged for the game of bowls. But you will see in these sections that in ivory the rings are usually concentric with the central nerve—or what is often called the nerve—which you will notice as a slight black speck in every billiard ball. The rounder and straighter the tusk, therefore, the better for ball making. Evidently, if the tusk is oval and the ball the size of the least diameter, its sides which come nearer to the bark or rind will be coarser and of a different quality from those portions further removed from this outer skin. Now, in this country there is practically but one size for billiard balls — $2\frac{1}{16}$ of an inch. We need not trouble ourselves with Continental sizes, which increase for various countries by sixteenths of an inch up to $3\frac{1}{2}$ inches. I may say here also that no country is so particular as our own; in fact, many foreign countries are satisfied with very indifferently turned balls. Bagatelle balls are usually made from returned cracked or chipped or old billiard balls. You may be deceived by the trade term "bagatelle points or teeth," which means really ball teeth of the English size. The spot in the spot ball is a plug of hard ebony, driven in and cemented. Balls are then matched, for extreme accuracy in weight is essential. They are then bleached; for the public, or, at any rate the distributing intermediary, prefers them of a dead white. But here they are wrong, for the operation of bleaching with chemicals, which takes out the gelatine to some extent, alters the quality and affects the density. It also makes the ball far more liable to cracks, and in fact shortens its life as a perfect ball. I, therefore, strongly advise you to insist on having unbleached balls. Another sorting will be for colour, centrality of nerve, and clear of bark, and for absence of bark discolouration. Those showing this are used for red balls. Formerly only soft ivory was used for best, the hard quality for cheaper balls. But since bonzoline has come in people like them of the same weight, and hard ivory is 10 per cent. heavier. On an average three balls of fine quality are got out of a tooth. I need not say much about bonzoline. Opinions still differ as to its value. Here are specimens. For my part, questions of price apart, I cannot conceive how there can be any difference of opinion; the one is alive, with its natural elasticity, the other stony and dead, and for beauty of appearance there can be no two opinions.

Well, now, a few words as to how billiard balls should be treated, so as to prolong their life in the most perfect condition. When first bought be careful never to subject them to sudden changes of temperature. And for some time at least do not bang them about or strike them hard with the cue. A professional taps gently always, and this gentle tapping is, in their early lifetime, a valuable assistance; balls treated in this way for six months or so are worth—well they are priceless in a way to a professional. One popular mistake is to buy new sets of ivory balls during the winter months: the sudden changes of temperature or draughts renders them liable to crack. Buy in the summer months and use them gently till the winter season: ivory is as delicate as the human frame, and requires to be acclimatised to new conditions, like ourselves. Roughly speaking, there are about twelve different qualities and prices of ivory billiard balls, and eight of pool and pyramid balls, the latter ranging from half a guinea to two guineas each. For ordinary qualities ivory balls are no dearer than bonzoline. Somewhat connected with the turning of spheres such as billiard balls is the making of the well-known Chinese puzzle balls, concerning which much wonderment is often excited, as it is imagined that they involve the labour of a lifetime. This is by no means the case: in fact they are not beyond the capabilities of any ordinary lathe worker. Here is a specimen, which is carved all over the outside. In this kind it might be possible to hide joins. Those which are quite plain are therefore more interesting. Shortly, in making them, the holes are pierced in such a way as to gradually diminish in a conical form to the centre. Each inner ball is then detached with parting tools, turning it round as the work proceeds. Our Chairman, Mr. Holtzapffel, whose family name is known throughout the world to all turners, and who is not only a Past Master of the Turners' Company, but a past master in the art itself, has been kind enough to bring the splendid exhibition of turned ivory which you see before you. I will ask him to add to his kindness by saying a few words concerning them.

My programme includes the consideration of the applications of ivory in the decorative arts, and it was my intention to carry you, if time permitted—by means of illustrations on the

screen—through the progress of the art of ivory sculpture in most countries and in all ages, showing especially the beautiful work of the Middle Ages. But the hour is now late, and I must ask your indulgence for omitting the early periods of this subject, and for confining my remarks to the position of ivory sculpture in our own times. Before doing so, however, I will touch briefly upon one or two intermediate points of interest. I intended to have spoken of the gigantic statues of gold and ivory attributed to Phidias in the great days of Greek art. Of these we have only records and no remains whatever. But the question, if and how the ancients managed to procure large slabs of ivory (and we find also very large ones amongst the Consular diptychs and in mediæval works) is often raised, and some have thought they knew some method of softening ivory. The old alchemists in fact give some marvellous and fanciful recipes for so doing. As a matter of fact, so far as our knowledge goes, ivory may be softened and reduced to a gelatinous mass, but it cannot be again restored to its original condition. Probably the chrys-elephantine statues were covered with slabs or thin plates of ivory which could be easily bent round to follow the contours. The effect close by would resemble a kind of mosaic, or the leading of stained glass windows, but at a great height such as these statues reached the joints would not be perceptible. It is interesting to recall, in connection with the raw material, the machine invented by M. Alessandri, shown at the Paris Exhibition of 1855, by means of which veneers of ivory in sheets as large as thirty by a hundred and fifty inches were produced.

In these days of collecting works of art, when the prices of first-rate specimens of the various branches has of late years become so high as to be prohibitory to all except the American millionaire, it is important that amateurs especially should be on their guard against the clever forgeries which abound. Ivories have not escaped. Some thirty years ago, the authorities of the Museum at Brussels paid £800 for a forged consular diptych—it would have been cheap to-day at ten times that sum —if genuine. The Louvre has suffered, and with the museums of Rouen and Lyons (some thirty years ago) bought three specimens of the very rare images of the Virgin, known as "Vierges ouvrantes." Quite recently, the first-named has been withdrawn as a forgery. A genuine example—the "Vierge de Bourbon"—brought at Christie's, three years ago, the large sum of £3,800.

In the spring of 1904 Mr. Craig-Brown, a well-known Scotch gentleman and collector of objects of art, being in Italy and passing through Bellagio, was much struck by what appeared to him to be a very fine ivory shield of large dimensions in the establishment of some dealers in the town. The shield, as you see it here, measured something over three feet in height with a corresponding breadth. The story told to Mr. Brown was that it was the property of the reigning Duke of Parma, presented to one of his ancestors by the royal family of England. You will observe the Tudor royal arms at the top. The price asked and given by Mr. Craig-Brown was £400. Well, to make a long story short, the thing is a fraud, a quite modern forgery, and the Duke of Parma knew nothing at all about it. Mr. Craig-Brown brought an action in the Italian Courts and eventually recovered his money. Meanwhile at his request I paid him a visit in London and saw the shield. In my judgment, as I told him, I believed the centre to be a modern copy with additions of a seventeenth century German ivory plaque by Antonio Leoni in the museum at Munich, the border adapted from a well known Renaissance steel shield in the Louvre. You will note, here, some differences which have been made. But mind you, at the same time, I think it is every bit as good as —whatever may have been his value as a sculptor—it would have been if a genuine work by Antonio Leoni. Passing through Brussels some months ago Mr. Craig-Brown was not a little startled to find an identical copy for which the same price £400 was asked in the establishment of M. Nossent in the Rue de la Madelaine—he may as well have the benefit of the advertisement—and I heard only yesterday that you can get another one, same price, in Venice. Now all this is, I think, very instructive, and there is a further moral. Why do we not buy for the actual beauty of things, the beauty we ourselves may see in them? As I said just now the seventeenth century sculptor could not have turned out better work. And again, sometimes it is the biter who is bit I think. You buy at a cottage in Clovelly, for instance, what you think a find, a genuine piece of Della Robbia ware, let us say, for a pound or two. It turns out to be a clever imitation. Are you justified in reproaching the wily cottager or his employer, or on the other hand, if really genuine, how much of the £1,000 or so which you might realise would you think you were

called upon to present to the ignorant original possessor?

In all works of art, so clever is the modern forger that the greatest experts are constantly deceived. If you are not an expert, and indeed, if you are, always verify what may be called the *état civil*—the life history of the object offered to you.

Few people, so far as my experience goes, even amongst those who are generally interested in works of art—seem to be aware of the extent to which ivory sculpture is practised at the present day by distinguished artists. We know that it is used for such prosaic things as billiard balls, paper knives, cutlery handles, and toilet objects, and other objects of utility which we are accustomed to see in shop windows. Visitors to Dieppe also know that it is still famous as a centre of ivory carving, that crucifixes and figures, fansticks and knick-knacks of all kinds which may be qualified as art of a certain kind abound there; that Chinese and Indian productions of a similar kind answer to the demand that is made for them; and that in recent years, Japanese figures of a better type command comparatively high prices. But I am often asked whether any of our best modern sculptors work in ivory, and when we consider the beauty of the material, the esteem in which it is held by artists, and their willingness to use it, the surprise to me is very great that so little is generally known concerning the practice of ivory sculpture, and the beautiful work which has been executed by our most distinguished artists. Now and again a figure or two may be observed at our Royal Academy, or perhaps a modest attempt at decorative work manages to insinuate itself at an exhibition of Arts and Crafts. But they are not the fashion; they attract some desultory attention, are acquired by a discerning collector, disappear, and are forgotten by the public at large. We have no museum for the encouragement of modern art like the Luxembourg at Paris, there is no fashionable lead, and the encouragement of ivory sculpture would appear not to be within the terms of the Chantrey bequest.

Then again, ignorance concerning art in ivory still requires to be dispelled amongst the authorities who rule and manage our international exhibitions. Otherwise, would it be possible to believe that at these—certainly up to that at Paris in 1900—ivory carving has been classed with leather-work, brush-ware, basket work, and a number of other industries. The same juryman would be called upon to adjudicate on the decorative sewing of a boot, or the art value of a carved meerschaum pipe and the merit of a *chef d'œuvre* of ivory sculpture by a Frampton or a Dampt. It is little wonder then that artists of distinction declined to exhibit under such conditions and that the public should remain in ignorance. Yet after all nothing is more certain than that the most distinguished amongst our sculptors have been accustomed to work in ivory. And it is pleasant to see that in recent times attempts have been made to place the art of ivory sculpture in the position which it once held and which it is entitled to hold; that is to say on an equal footing and in an equal place of honour with sculpture in marble or bronze or in any other material. A first exhibition was held in Brussels some twenty years ago at which all the most distinguished amongst the Belgian sculptors and some fifty others exhibited, and the year before last a most successful exhibition was held in Paris. It is true that in order to justify the expectation of a revival of ivory sculpturs more than this is required. But everything must have a beginning. A great deal depends on the trend of fashion, that is to say of patronage. It is useless to ignore this fact. Huge sums are given by the wealthy patrons of art for specimens of the antique, more or less genuine, the bulk of which goes into the pockets of the dealer. What is necessary is that their tastes or inclinations should turn in the direction of the modern, of the living artist.

The profession of sculpture demands in many ways expense. From the point of view of the quality of the material it costs as much to execute a bust or a statuette in ivory, a foot or so in height, as to produce a life-size statue in marble. The sculptor is only too willing to use ivory as a medium, but he cannot be expected to sacrifice his material interests and educate the public at his own expense. Those whose work in ivory I shall presently briefly bring under your notice are in the first place great sculptors in marble. They naturally in another direction have regard to public requirements. Ivory is a delightful material to work, delicate and graceful in results, grateful in every way to the artist. It is to monumental sculpture what the miniature is to painting—or rather it takes its place with bronzes and goldsmith's work. Any sculptor can work it. It requires no special knowledge or training. But from about the time of the Italian renaissance it got into bad hands and became the product of the workshop rather

than of the studio of the artist—there being all the time, however, in every age, sculptors of the highest distinction who kept alive its traditional position and redeemed its character. Still, generally speaking, as an art it fell, and suffered from its mechanical abasement. To the public now-a-days, carving in ivory suggests China or India, or Dieppe, nothing more. People may pay for such things what they may be worth, but it is not at such a price that a sculptor of reputation can work. Then, again, the Church. When one thinks of the examples of ivory sculpture destined for the service of religion — the diptychs and triptychs, pastoral staves, statuettes and crucifixes of the thirteenth and fourteenth centuries—one marvels at the horrors which have taken their place since the patronage and influence of the Church on art no longer are of value. And again, if one remembers the large sums obtained for a Byzantine or mediæval ivory casket, one cannot help thinking what a great artist could produce if he were offered adequate inducement. What could be more appropriate for presentation caskets than a simple one in ivory deriving the principal value from the work of a great sculptor: what more worthless than the hideous productions of the silversmith's shop which our Corporations present to foreign potentates and distinguished guests, or as prizes for distinction in the field or in sports?

Who, then, are the great sculptors to whom I have referred as being so little generally known? I wish indeed that there remained more time at my disposal, enabling me to do more than briefly refer to their work. The revival of ivory carving in quite recent times is due to Belgian sculptors. This is as it should be, for throughout the golden age of ivory sculpture in the thirteenth and fourteenth centuries Flemish artists were particularly distinguished: and again, in the days when the art of the rococo ran riot, the Fiammingos, the Van Opstals, and the Fayd'herbes were the masters when decadence reigned elsewhere. So it is at the present day that, encouraged by the proprietor of the Congo to make fashionable a material which is one of the most valuable products of that possession, we have in ivory some *chefs d'œuvre* from the hands of such well-known sculptors as Julien Dillens, Meunier, Van der Stappen, Wolfers, and Samuel, not to mention a considerable number of lesser lights. Here is the charming statuette "La Gloire" of the first-named, and the "Feé au Paon" of Wolfers. Wolfer's work —he is also a goldsmith—is nearly always an admirable combination of ivory with gold, silver, enamels, precious stones, and semi-precious marbles. In France I can only mention—for there is no time to do more—that such sculptors of the very first rank as Jean Dampt and Theodore Rivière, amongst a host of others, give us yearly most charming work in ivory. This is his famous "Salammbô chez Mathô." The original is in the Luxembourg. Dampt and others are famous also for busts and figures in ivory, or in ivory in combinatiou with wood and other materials—portraits of celebrities and leaders of high life which ought to set a fashion, and may become the rage. Then again, ivory is largely used by such great artists as Lalique, and by Gardet and others, for beautiful toilet articles, such as hair-pins and combs, mirrors, fans, and the like. And so to come to England: and if it cannot be said that we can produce an extended list of workers, on the other hand, it will be admitted that they number amongst them our greatest names. This is Frampton's beautiful "Lamia," exhibited at the Academy in 1900, and now in the collection of Mr. Willy Vivian. It is the "Lamia" of Keats—in ivory and bronze, at the moment of the transformation. The face, with its studied serenity—cryptic, snake-like—is carved in life-size from a very fine block of beautifully-grained ivory, which was supplied to the sculptor by the very long-established firm of ivory dealers, Messrs. Myers and Son, of Tower-hill. Mr. Frampton tells me that for some things he prefers the soft variety of ivory, for others the hard, and that he always uses live in preference to dead ivory. For large work a large grain is effective, for smaller, certainly less grain and closer texture. The block used for this bust weighed some fourteen pounds. Whether ivory in sculpture should be polished, or matted till it is almost like white marble, as some sculptors make it, and how far it should be used alone or in combination with other materials, are questions to which I can do no more than allude. Other admirable English sculpture in ivory in various private collections—our public ones possess not a single example—include the work of such names as Alfred Gilbert, the late Harry Bates, and Reynolds-Stephens, and at Lloyd's Registry you will see it beautifully used in the freize by that clever young sculptor, Lynn Jenkins.

The subject of my lectures is so important, and covers such a large extent of ground, that, as you will have observed, I have, on each evening, been compelled to skip and abbreviate, and offer you scarcely more than indica-

tions for your consideration. As a matter of fact it would not be difficult, I think, to make at least ten divisions, each one of which would afford more than sufficient material for an evening's lecture. But I shall be satisfied if the points I have indicated may have been sufficiently interesting to induce some of my audience to inquire further—there is ample and beautiful material in our great museums —and at any rate I am sure it will be admitted that ivory and its applications have played a more important part in the history of civilisation than at first sight might appear evident, that the material itself and its working is full of interest, that its usefulness enters largely into our daily life, and that in the history of art it has a place which is on a level at least with any other of the sculptural arts, not excluding, indeed, as I said in my first lecture, even the graphic arts.

APPENDIX.

Statistics of Imports and Exports extracted from the Board of Trade returns.

IMPORTS OF IVORY INTO THE UNITED KINGDOM.

Countries whence exported.	Year (1900). Cwts.		Year (1904). Cwts.
Russia	301	....	4
Germany	783	....	742
Holland	625	....	309
Belgium	1,930	....	2,015
France	461	....	446
Portugal	95	....	35
Egypt	218	....	1,140
Tripoli	144	....	114
French West Africa	223	....	587
Portuguese West Arrica	152	....	87
German West Africa	201	....	464
Congo	72	....	41
Portuguese East Africa	258	....	77
United States	604	....	401
Other Foreign Countries	107	....	117
Totals	6,174	....	6,579
British Possessions:—			
Malta	390	....	162
Gambia, Sierra Leone, Gold Coast, Lagos	113	....	119
Niger	469	....	55
Cape	10	....	5
Zanzibar	1,687	....	825
Aden	572	....	131
Bombay	351	....	716
Madras, Bengal, Burmah	14	....	9
Straits	24	....	—
Ceylon	2	....	—
Other British Possessions	83	....	891
Totals, British Possessions	3,715	....	2,466
Totals, Foreign Countries	6,174	....	6,579
Grand total	9,889	....	9,045

Imports.			Average per cwt.	Exports.
Year.	Cwts.	Values.		Values.
		£	£	£
1890....	14,349	755,164	52	444,811
1891....	10,952	549,359	50	380,747
1892....	11,505	559,083	48	332,720
1893....	10,018	477,001	47	247,376
1894....	10,394	422,735	40	249,426
1895....	10,911	467,976	42	272,857
1896....	10,911	459,181	42	203,325
1897....	10,288	422,398	41	205,931
1898....	9,002	410,511	41	238,557
1899....	9,939	404,063	40	201,841
1900....	9,889	398,654	40	234,332
1901....	8,825	335,710	38	207,132
1902....	10,821	398,229	36	225,848
1903....	9,241	339,855	36	256,909
1904....	9,045	361,685	39	236,403

EXPORTS.

Countries to which exported.	1900. Cwts.		1904. Cwts.
Germany	2,186	....	2,079
Belgium	63	....	87
France	635	....	1,062
Italy	21	....	—
Turkey	89	....	93
Japan	117	....	54
United States	1,078	....	766
Other Foreign Countries	70	....	66
Bombay	1,491	....	1,194
Hong Kong	66	....	—
Other British in India	12	....	5
Total Exports	5,830	....	5,376

VEGETABLE IVORY.

Imports.

Germany	8,632	....	7,883
Republic of Columbia	2,050	....	8,834
Ecuador	3,043	....	5,293
Peru	—	....	1,438
Total Foreign	13,725	....	23,448
,, British Possessions	227	....	16
Total Imports	13,952	....	23,464

Exports.

Germany	923	....	7,427
France	1	....	83
Other Foreign Countries	426	....	—
Total Exports	1,350	....	7,500

Extracts from Statistical Papers and other Tabulated Statements prepared by, and laid on the table by the Lecturer.

From Messrs. Hale and Sons (ivory brokers, 10, Fenchurch-avenue) Ivory Report of the second quarterly sales in London, April, 1906, it appears that the following were offered:—

From Zanzibar, Bombay, Mozambique, and Siam	17 tons
Egyptian	$19\frac{1}{4}$,,
West Coast African	11 ,,
Lisbon	1 ,,
Abyssinian	$6\frac{3}{4}$,,
	55 tons
Sea horse (hippopotamus teeth)	$1\frac{3}{4}$,,
Walrus	$\frac{1}{4}$,,
Waste ivory	$10\frac{1}{4}$,,
	$67\frac{1}{4}$ tons

Hard ivory was scarce. West Coast African was principally of the Gaboon description, and some of very fine quality. There was very little enquiry for Walrus. The highest prices ranged as follows:—

Soft East Coast tusks [Zanzibar, Mozambique, Bombay, and Siam], 102 to 143 lbs. each, £66 10s. to £75 10s. per cwt.

Billiard ball scrivelloes, £104 per cwt.

Cut points for billiard balls [$3\frac{1}{8}$ in. to $2\frac{3}{8}$ to 3 in.], £114 to £151 per cwt.

Seahorse (for best), 3s. 6d. to 4s. 1d. per lb.

Boars tusks, 6d. to 7d. per lb.

Table showing the quantities of Ivory offered to Public Auction during the last three years (from Messrs. Hale and Son's Reports).

	1903. Tons.	1904. Tons.	1905. Tons.
Zanzibar, Bombay, Mozambique and Siam	81	75	76
Egyptian	$49\frac{3}{4}$	$72\frac{3}{4}$	$81\frac{3}{4}$
Abyssinian	$22\frac{3}{4}$	$9\frac{3}{4}$	$23\frac{1}{4}$
West Coast African	$46\frac{3}{4}$	$39\frac{1}{2}$	$41\frac{1}{2}$
Lisbon	3	3	$1\frac{3}{4}$
	$203\frac{1}{4}$	200	$224\frac{1}{4}$
Seahorse teeth and Boars' tusks	7	$9\frac{3}{4}$	$7\frac{1}{4}$
	$210\frac{1}{4}$	$209\frac{3}{4}$	$231\frac{1}{2}$

Fluctuations in Prices of Ivory at the London Sale Room in each Tenth Year or so from 1870 to 1905. (Taken from Messrs. Hale and Sons Charts, which show the prices at each quarterly sale from 1870 to date.) Note.—The fluctuations vary greatly between the periods given below:—

	1870.	1880.	1890.	1900.	1905.
	£	£	£	£	£
Billiard Ball pieces	55	90	112	68	167
Hard Egyptian 36 to 50 lb. average	30	38	50	29	48
Soft East Indian 50 to 70 lb. ,,	67	55	88	57	72
West Coast African 50 to 70 lb. ,,	36	57	65	48	61
Hard East African 50 to 70 lb. ,,	37	49	64	48	61

In October, 1889, soft East Indian fetched an average of £82 per cwt., but in several instances higher prices were realised, and one lot reached £88 per cwt.

Table showing the Highest and Lowest Prices in the Intermediate Years of the above Period.

		1870 to 1880.		1880 to 1890.		1890 to 1900.		1900 to 1905.	
			£		£		£		£
Billiard ball pieces	(highest)	1874	78	1889	101	1895	105	1902	94
	(lowest)	1870	50	1886	73	1893	68	1903	82
Hard Egyptian	(highest)	1873	50	1889	48	1899	37	1904	38
	(lowest)	1871	25	1887	36	1895	24	1901	30
Hard East Indian	(highest)	1875	63	1889	62	1891	56	1903	49
	(lowest)	1871	33	1879	45	1895	38	1901	41
Soft East Indian	(highest)	1872	66	1889	68	1889	48	1904	57
	(lowest)	1870	39	1886	57	1897	52	1901	54
West Coast African	(highest)	1872	66	1889	68	1892	51	1904	57
	(lowest)	1870	35	1886	50	1894	36	1901	37

Messrs. J. B. Thomson and Co's Ivory report shows that at the second quarterly sales in Liverpool in April, 1906 (the latest we have to hand), about $7\frac{1}{4}$ tons were offered from Gaboon, Angola, and Cameroon (from the last, $5\frac{3}{4}$ tons). The highest price realised for 10 lbs. solid scrivelloes was £61 10s.

The following short abstract relating to Belgium is taken from the "Rapport de la Chambre de Commerce d'Anvers" and from the "Tableau général du Commerce de la Belgique avec les Pays Etrangers":—

PORT OF ANTWERP.

Imports.

Year.	Cwt.
1890	1,550
1900	6,650
1903	7,090
1904	6,830, value £341,500
1905	6,570, ,, £390,000

Of the total imports to Belgium of 6,830 cwt. in 1904, of a value of £341,500, 5,310 cwt., of a value of £265,500, were from the Congo Free State; in 1905 the State sent 4,890 cwt. With regard to the export of 6,830 cwt. from Belgium in 1904, America took the largest quantity, amounting to 2,920 cwt. England came next with 1,220 cwt., then France, 1,010 cwt., Germany, 670 cwt., Hamburg, 590 cwt. The remainder went to British India, 14 cwt., the Netherlands 13 cwt., Russia 9 cwt., Switzerland 5 cwt., and about 400 cwt. to other countries.

The ivory traffic of the port of Antwerp, alone, in 1904, amounted to—Imports, 6,360 cwt., of a value of £320,000; exports, 4,870 cwt., of a value of £244,000.

Note.—In the Belgian statistical information, gathered from the official returns, it should be borne in mind with regard to ivory, that the term *Commerce général* (from which the figures above are taken) refers to the total quantity entering the country, whatever its ultimate destination may be. *Commerce spécial* means that which, *at its entry*, is declared as to be used in the country. But in the case of ivory, as it pays no Customs duties, this distinction is not to be taken literally. As a matter of fact, a very small quantity indeed remains in the country for internal consumption. With regard to the figures given, the weights may be taken as fairly correct, but the values are calculated on a uniform Customs basis of 30 francs per kilo.

Besides the specimens and other objects exhibited by the lecturer to illustrate the first and third lectures of the course, the following were kindly lent for exhibition and demonstration:—

By Mr. George Pauling.—Skull of a hippopotamus, with tusks and teeth complete. Head of a warthog, mounted. Japanese carved elephant tusk.

By Royal College of Surgeons.—Elephant tusks. Sperm whale tooth, engraved. Fine specimens of elephant molar teeth. Specimens of bullets and spearheads embedded in tusks. Longitudinal section of a fine hippo tusk, showing structure. Divers sections of tusks. Tooth of Australian dugong.

By Messrs. Holland and Puddifoot. — Native bangles. Abnormally large hippo tusk. Small elephant tusk (specimen of billiard ball scrivelloe) Specimen soft Egyptian tusk (to show cracking); section (rat gnawed). Milk tooth of elephant. Abnormalities (twisted tusks, double hollows, diseased hollows, stale hollows, bubbles, osteo-dentine, *ringy* ivory &c.). Billiard ball sections, &c.

By Messrs. Myers and Co.—Skull of young walrus with tusks. Two large walrus tusks; section of ditto showing pith.

By Messrs. Keith and Co.—Three specimens with bullets embedded, one very curious, with spearhead. Specimens of hard and soft ivory heads and tails for piano keys, bleached and unbleached.

By Messrs. R. Stevens and Sons, Villiers-street, W.C.—Tusks and billiard balls.

By Messrs. Broadwood and Co.—Complete piano keyboard in process of manufacture. Heads and tails for piano keys, hard and soft, in various stages.

By Messrs. Carter and Co.—Specimens of ivory billiard balls of various qualities. Specimens of bonzoline balls. Sheets of ivory for veneer. Specimens of the manufacture of a billiard ball (with chucks, &c.) in all stages, from the section of tusk to the finished article.

By Messrs. Rodgers and Co., Sheffield.—Knives and knife handles in all the different qualities. Two gigantic paper cutters, made from whole tusks. A fine carved tankard (modern work).

By Messrs. Rowland Ward and Co.—A fine hippo tusk.

By Mr. Phillip Landstein (ivory dealer, Queen's-road, Bayswater).—An ivory whip cut from a tusk (showing flexibility).

By Mr. James Gardner, Oxford-street, .—A very fine specimen of Narwhal tusk or defence.

By Mr. G. Holtzapffel (Past Master Turners' Company, &c.).—A very large collection of all kinds of curious turned work in ivory.

The lectures were further illustrated by large photographs of modern sculpture in ivory, amongst others, the "Lamia," by Frampton, and works by Alfred Gilbert and Reynolds-Stephens, "Fée au Paon," and a very large ivory cabinet by Phillippe Wolfers, of Brussels. Five statuettes and groups by Samuel, of Brussels. "La Gloire," by Julien Dillens. "Salammbô chez Mathô," by Theodore Rivière. Examples of the work of Dampt, Caron, Scailiet, Paul de Vigne, Gardet, Lalique and others.

THE AMERICAN SILK INDUSTRY.

The Silk Association of America, in its half-yearly review of the silk industry, states that the present equipment of the American mills is equal to an output, for broad silk fabrics alone, of £17,187,000. A limited supply and consequent high cost of raw materials tend to limit the production. Assuming twelve pounds per throwing spindle to be the average production of the present "throwing" equipment of the United States, say 1,300,000 spindles, we find a consuming capacity in the silk texture industry of 15,600,000 pounds of raw silk; add present consumption by machine twist and sewing silk branch of the industry, 1,700,000; add probable present consumption by other textile industries (not including spun silk yarns), cotton industry, 500,000; wool industry, 250,000; hosiery and knitted goods, 250,000, and we find a total existing capacity for 18,300,000 pounds of raw silk. To this may be added the consumption of raw silk, which does not require to be "thrown," for dress goods weaving, but which is being used in increasing quantities for raw silk warps by silk piece goods manufacturers, and by cotton manufacturers as an element for filling in dress goods woven principally on cotton warps. So called "weaving in the raw" is decidedly on the increase in the United States, and some experts estimate the quantity so used at the present time as high as 2,500,000 pounds of raw silk. In the past thirty years the world's supply of raw silk has almost doubled. In the twenty years—1885-1905—it increased 91 per cent. In the last-named period Italy increased her output of raw silk from 6,195,000 pounds to 10,803,000 pounds, say 75 per cent.; France increased her supply from 1,065,000 pounds to 1,378,000 pounds, or 30 per cent.; the exports from Canton and Shanghai (not including tussah silks) rose from 7,648,000 pounds to 11,216,009 pounds, or 46·7 per cent.; while the most notable increases were from Japan, 2,967,000, to 12,521,000 pounds, or 322 per cent. more in 1905 than in 1885, and from the Levant, 1,609,000 pounds in 1885 to 4,819,000 pounds in 1905, or 200 per cent, China is the largest raw silk producing country in the world, but the above figures show continued commercial indifference of her Silk Guild to the trade wants of her customers in raw silk outside her own borders. Since the United States census of 1900, there has been a steady and important increase in the consumption of Italian raw silks in the American market, the percentage of increased receipts being greater than any other country. Under ordinary crop conditions Italy now supplies about 25 per cent. of the American consumption, as against 19·7 per cent. in 1900. The United States alone took 42 per cent. of Italy's raw silk product in 1905. The increase in broad power looms shows plainly the trend of productive progress during the last few years. At the beginning of 1906 there was a total of 55,000 power looms, representing an increase of 49·4 in this branch of weaving in five years. The increase of 17,423 looms of the largest productive capacity (37 inches and over) in five years is a noticeable fact. In narrow-fabric weaving there are at present 10,100 power looms. The actual percentage of increase of high-speed looms in the last five years is 133. In the throwing branch of this industry the increase has been 23·9 per cent. in the last five years. There are now 703,250 first time organzine spindles, 452,779 second time organzine spindles, and 138,769 tram spindles, making a total of 1,294,798 spindles.

THE CONSUMPTION OF MEAT IN GERMANY.

According to recently published statistics, there is a further reduction in the meat consumption in Germany. In the first quarter of 1906 it was not only less than in the last quarter of 1905, but also shows a decrease as compared with the first quarter of 1905. *Per capita*, the population of Germany used during the first quarter of 1906 20·9 pounds of meat, during the fourth quarter of 1905 21·4 pounds, and during the first quarter of 1905 22·2 pounds. The decrease would have been still greater had not the importation of meat during the period given been extraordinarily forced in anticipation of the new customs tariff. The number of beeves and other meat-producing animals slaughtered in all Germany during the first quarter of 1906 was only 5,770,127, as against 6,444,550 in 1905. The greatest decrease is shown in the consumption of pork per head of the population. The consumption of pork fell from 11·6 pounds during the first quarter of 1905 to 10·1 pounds during the first quarter of 1906. This is rather surprising in view of the fall in the price of pork in various parts of Germany. The German cattle market this year has thus far shown less strength than during the preceding year. A substitute for pork has been sought as far as possible in beef and veal, which, while often not dearer than pork, are, nevertheless, not considered so nourishing. Moreover, there has been only a very slight increase in the consumption of beef over the previous year. The percentage of mutton and goat flesh consumed in Germany is insignificant, amounting at the most to not more than ·44 of a pound *per capita*. In Alsace-Lorraine the scarcity of meat was somewhat relieved by families living along the German boundary sending their children over into France, where they could purchase meat in quantities not exceeding three or four pounds, and return to Germany without paying any import duty. The meat could be purchased in France for from three halfpence to twopence per pound less, and by each child bringing into Germany a quantity of meat, large quantities were brought in. French butchers settled along the frontier, and did a thriving business for some months, but this sort of importation has been prohibited. In Alsace, calves are selling at sixpence per pound live weight. At present corned beef is being sold in Strassburg, put up in tin boxes to resemble the American article, and bearing labels printed in English, but this beef is said to be packed in Hamburg.

HOME INDUSTRIES.

Cornish Mining.—As was anticipated when the price of tin touched £200 per ton, and exceeded it, the owners of many of the Cornish tin mines that have been shut down for many years have commenced to bestir themselves with the object of re-opening, under the more favourable conditions of the present time. One property which closed down in 1895 has resumed operations, and, in inviting the public to provide the necessary working capital, some noteworthy facts are mentioned:—When the mine was closed eleven years ago it was worked under the cost-book system—it was producing block tin at a cost of £55 per ton, and selling it at an average of £49 per ton. Taking to-day's prices, instead of a loss of £6 per ton, the gross profits would be over £60 on every ton sold. Nor is it only the great change in prices that is so noticeable. During the last five years of the working of the property the average recovery was 36 lbs. of black tin per ton of ore treated, but there was at least 25 per cent. unextracted. Under the more scientific treatment of to-day it may be safely assumed that the recovery from the same ore would not be less than 40 lbs. And whilst there has been very great appreciation in the market price of tin, and improvement in extraction, working costs have decreased. Under the cost-book system they were roughly £1 per ton of ore treated; under present methods these costs are substantially less. It is surprising that the Cornish tin and copper producing companies have been content until now to retain the antiquated and ineffective system of working of centuries ago. The cornish tin mines have been shut down one after another because those who worked them could not make them pay, and whilst of course many causes have combined to bring about this unprofitable state of things, the style of working has had much to do with it. Fortunately some of the more important mines are now worked on modern principles, and promise to be worked profitably even when prices are considerably lower than they are at present. The over lord, too, is readier than he used to be to accept moderate royalties. Although the outlook for Cornish tin mining is more hopeful than it has been for many years past, substantial difficulties have still to be reckoned with, but with tin at anywhere near its present price, experts are of opinion that many of the mines still shut down might be profitably worked. And there is little likelihood of the price of tin falling back to the quotations of ten years ago. Consumption is steadily increasing, and it it not easy to see how the supply is to be largely increased. Even with copper the growth of production is a slow process, but there are immense deposits of copper both in South and North America and Africa, which will, in course of no very long time, be marketable. But it is different with tin. In the Malay States the output seems to have reached its maximum, and elsewhere, although rumour is busy as to the discovery of rich deposits, there is no present likelihood of much increase in exports.

Copper Consumption.—The increase in the consumption of copper during 1906 by the leading manufacturing countries of Europe is shown in the following figures taken from Messrs. James Lewis and Son's report. They refer to the first nine months of the year, and show that England has absorbed 50,400 tons, as compared with 43,000 tons in the corresponding period of 1905; France 41,100, as against 35,900 tons; Germany 91,300, as compared with 73,300 tons; and Italy, Austria, and Russia 14,800, as against 18,900 tons. The figures for Germany are very noteworthy. The United States has supplied 146,900 tons of this quantity, an increase of 9 per cent. as compared with 1905. Messrs. James Lewis and Son say there is now a plentiful supply of copper in Europe, the recent imports having been exceptionally large. There is scarcity in the United States, but it is not likely to be of long continuance. "Strenuous efforts," they say, "are being made to increase production, and in Arizona alone, the additional output is expected to be 2,500 tons per month. In the Lake Superior district more men are employed than ever before, and in Montana mines capable of yielding 3,000 tons per month, which for some time have been idle, are again in operation." This is good news for the electrical and other industries affected by the price of copper.

The Hotel Industry.—The reports and accounts of the leading hotel companies are now appearing, and they afford much interesting information as to their position. Hotel companies have felt the recent depression in trade more severely than many others, but the accounts now issued of representative concerns show recovery. For example, Frederick Hotels, Limited, own hotels in London, Margate, Folkestone, Dover, Bexhill-on-Sea, Harrogate, Whitby. As compared with last year, the income has risen from £321,700 to £336,084, and the expenditure has fallen from £256,132 to £253,026. The result is that the company is able to pay a dividend of 5 per cent. on its preferred ordinary shares, and 4 per cent. on the deferred ordinary, as compared with nothing for the previous year, and £10,000 is appropriated for starting a reserve fund. The Hotel Cecil, Limited, has only the one company that gives it its name. Here, again, the record of the year is one of improvement, the gross business having risen from £201,138 to £229,030, an increase of £27,892, but in this case there has been an increase in expenses from £172,093 to £188,091. The net profits amount to £51,766, as compared with £38,487 last year, and enable the company to pay a full year's dividend on the preference shares. There are still, however, one year's arrears to be provided for. The third hotel company to which reference may be made is the Carlton, perhaps the most striking of all successes in hotel ventures. The net profits have risen from £56,798 to £57,887, a small increase as compared with the other companies named, but then last year the Chairman told shareholders at the annual meeting

that during the year they had had the lion's share of the business catered for, and "it is practically impossible to make any appreciable increase in the business we transact at present." The Carlton Hotel, Limited, is one of the few companies which have done better than prospectus promises. The prospectus estimated profits as likely to amount to £40,000 per annum. This estimate was largely exceeded from the first. In 1900 the profit was £52,310 ; in 1900 it rose to £63,762, and it has never been lower than the profit of the first year. The hotel is now working at its fullest capacity, and the company has a very large interest in the Ritz Hotel recently opened. The figures given, and affecting the three hotel companies named, indicate the large profits earned by leading hotels. Other large hotels, such as the Piccadilly and the Waldorf, are in course of construction, and many are of the opinion that London will soon be over-supplied with these immense establishments ; but that remains to be seen.

The Cycle Trade.—The present position of the cycle industry is a striking illustration of the truth that a small profit on a large turnover is better than a large profit on a small turnover. 1897 was what is known as a "boom" year in the cycle trade. Large profits were made, but these profits were due to inflated prices. Cycles were then more or less of a luxury, now they are a necessity. It is not possible to give the average price per machine in 1897, but it is safe to say that it was more than double the present rate. After the "boom" came the inevitable collapse, and for several years the trade was in a very unsatisfactory condition, but for some years past it has been gradually recovering, and it was never as sound as it is to-day. It is not possible to give the figures of the home trade, but those relating to our foreign trade are available. They show that in 1897 the exports were of the value of £1,430,320, and they gradually fell away until in 1900 they were valued at only £530,950. From that time onwards there has been steady recovery until last year they were valued at £945,490. It must be remembered in this connection that whereas in 1897 the average price worked out at about £16, last year it was not more than £6 per machine, so that the improvement in the export trade in recent years has been much greater than the values would seem to indicate. In 1897 the imports of cycles were valued at £527,413, in 1904 the value fell to £82,784, and although last year it rose to £130,288, this was due to the importation of parts, rather than complete machines. The American machine, once so predominant in the English market, is gradually disappearing. The figures for the preseut year of exports and imports are still more satisfactory. Taking the nine months to September 30th, and comparing the two years, the following results are shown :—

Nine months.	Exports. £	Imports. Cycles. £	Parts thereof.
1905	685,746	10,625	91,994
1906	863,215	6,902	113,935

The value of the imports of cycles, which for the nine months ended September 30th, 1902, amounted to £74,889, has fallen this year to £6,902. True, the value of the imports of parts has increased from £50,394 to £113,935, but that is another matter. Our manufacturers are gradually ousting the foreign machine, and making renewed headway in foreign markets. It may be expected that the motor industry will follow closely on the lines of the sister cycle trade. At first a luxury within the reach of none but the rich, inventors will continue to improve upon existing types until, before many years have passed, there will be a great reduction in prices. It may be a long time before the price of a motor falls sufficiently to bring it within the reach of the man of small means, but it is only a question of time. Meantime the history of the cycle industry shows that it is not the buyer only who benefits from prices, that bring an article within the reach of the many.

The Rating of Railways.—The chairmen of railway companies are in the habit of inveighing at annual meetings against municipal authorities who, as they contend, treat them unfairly in assessments, and the result of a recent arbitration lends colour to the complaint. Last year, when the valuations were being made up, the Hampstead Borough authorities increased the assessment of the Midland Railway Company from £9,762 to £14,000, or between 40 and 50 per cent. The directors of the railway company resolved to appeal, and the matter was referred to the arbitration of Mr. Lyttelton, K.C. The hearing took five days and at the close of the fifth day counsel for the Hampstead Assessment Committee intimated that it was hopeless to attempt to convince the arbitrator that £14,000 was a proper assessment, and he actually agreed on behalf of his clients to a rateable value not at the old figure of £9,762 but of £5,570, the borough paying the company's costs. It may be expected that the result of this appeal will encourage other railway companies to resist what they consider unfair assessments.

GENERAL NOTES.

Smyrna and Sultana Raisins.—Some years ago the cultivation of sultana raisins, the principal industry of the Smyrna district, was seriously crippled by the ravages of the phylloxera. To encourage farmers to replant their ruined vineyards the Government granted special facilities in the shape of relief from taxation, and free supply of American vine stocks. This policy proved successful, with the result that the production has greatly increased. Unfortunately last season, partly owing to glut, and partly perhaps to economic conditions prevailing in the consuming markets, prices fell so low that farmers had to part with their produce under cost

price. At this juncture an enterprising firm imported a new apparatus whereby, by means of sulphurous bleaching, they so thoroughly cleaned and "coloured" an inferior article that it was made to look as good as the better one. The innovation was described as revolutionary in the trade, and calculated to bring ruin to the staple industry of the district if not checked in time. It was urged that by artificially improving the appearance of the inferior article the new process would disastrously affect the market value of the really good article. It was also suggested that the sulphurous bleaching rendered the raisins injurious. The Government, after some hesitation, formally gave its sanction to the new process, which has now become general. Meantime prices remain very low, and the Government, says Mr. Whintop, of the British Consulate General (Cd. 2682), from which this is quoted, has been urged to approach the British, Austro-Hungarian, and German Governments with a view to inducing them to reduce their respective Customs' tariffs in regard to Turkey raisins.

Cotton on the Gambia and the Gold Coast.—Mr. H. M. Griffiths' report on the Gambia to the Government of that Colony is not very encouraging so far as the cultivation of cotton is concerned. In 1902 the British Cotton Growing Association, strongly supported by the Government, endeavoured to push the cultivation of cotton among the natives. Experiments continued until early last year, when it was decided to discontinue any further efforts in this direction, it being impossible to induce the natives to grow cotton at the price offered for it by the Association. Mr. Griffiths says that large quantities of cotton were planted in 1904, and but for the drought, and for the plants being attacked by the boll-worm, a yield of 250 to 300 lbs. to the acre might have been expected. But the Association only offered 1d. a lb., and as the natives can get 3d. a lb. for the cotton among themselves the Association obtained very little of it. Taking the yield per acre at 300 lbs., which Mr. Griffiths says is all that can be expected for some years to come, a penny per pound would only give the farmer £1 5s., whereas ground nuts yield him, on the average, 60 bushels to the acre, which at 1s. 6d. a bushel, a fair average price, gives him £4 10s. The total expenditure in connection with the cotton experiment has been £3,429. On the other side of the account, 189,492 lbs. of cotton were purchased and realised £1,579, so that the loss on the transaction has been £1,850, of which the Government share has been over £1,500. Reporting upon the affairs of the Gold Coast, the Acting Governor says that the experimental farm at Labolabo was cleared during the past year to its full extent of 200 acres, a farm at Anum being abandoned as the site was found to be unsuited for the cultivation of cotton. The Superintendent of Agriculture for the West African Colonies and Protectorates reports that the cotton grown at Labolabo "was as good as possible, and as an object lesson to the natives living in the district it was quite a success, and as a consequence cotton has been grown to some extent in the neighbourhood on the assumption that there might be a local market for it." The British Cotton Growing Association has taken over the farm, the Government agreeing to contribute for three years half the cost of the up-keep, subject to a maximum limit of £1,500 a year. At least one of the cross-fertilising experiments carried out by the Director of Agriculture promises to be successful, and the yield from a plot planted with a hybridised variety was about 1,200 lbs. of seed cotton per acre.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. D. Hall, "Artificial Fertilisers: their Nature and Functions." (Lecture I.)

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. J. Stanley Gardiner, "The Seychelle Islands."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. A. E. Henderson, "The Crœsus (Sixth Century B.C.) Temple of Artemis at Ephesus."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. C. Carus-Wilson, "Musical Sands."

Tuesday, Nov. 20...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Charles Frewen Jenkin's paper, "Single-phase Electric Traction."

Statistical, in the Theatre of the United Service Institution, Whitehall, S.W., 5 p.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. Albert Cheese, "Italy: Past and Present."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m.

Wednesday, Nov. 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Meeting of the Session. Inaugural Address by Sir Steuart Colvin Bayley, Chairman of the Council

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Dr. Hugh Robert Mill, "The International Congress on Polar Exploration at Brussels, September, 1906." 2. Mr. William Marriott, "The Abnormal Weather of the past Summer, and some of its Effects."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. J. W. Gordon, "The Use of a Top Stop for Developing Latent Powers of the Microscope."

Entomological, 11, Chandos-street, W., 8 p.m.

Thursday, Nov. 22...Antiquaries, Burlington-house, W., 8½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. T. Cato Worsfold, "The Ober-Ammergau Passion Play."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Professor J. Epstein, "Selection and Testing of Materials for Construction of Electric Machinery."

Friday, Nov 23...Botanic, Inner Circle, Regent's-park, N.W., 4 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

CONTRIBUTIONS TO THE READING-ROOM.

The Council have to acknowledge, with thanks to the Proprietors, the receipt of Transactions of Societies and other Periodicals.

TRANSACTIONS, &c.

Aeronautical Society, Journal.
African Society, Journal.
American Academy of Arts and Sciences, Proceedings.
American Chemical Society, Journal.
American Institute of Architects, Bulletin.
American Institute of Electrical Engineers, Proceedings.
American Institute of Mining Engineers, Transactions.
American Leather Chemists' Association, Journal.
American Philosophical Society, Proceedings and Transactions.
American Society of Civil Engineers, Proceedings.
American Society of Mechanical Engineers, Transactions.
Architectural Association, Notes.
Association of Engineering Societies (American), Journal.
Australian Official Journal of Patents.
Australasian Association for the Advancement of Science, Report.
Bath and West of England Society, Journal.
British Association for the Advancement of Science, Report.
British Dental Association, Journal.
British Fire Prevention Committee, Publications.
British Horological Institute, Horological Journal.
Brussels, Société d'Etudes Coloniales, Bulletin.
———, Travaux Publics de Belgique, Annales.
Canada, Royal Society, Proceedings and Transactions.
Canadian Institute, Transactions.
Canadian Patent Office, Record.
Canadian Society of Civil Engineers, Transactions.
Central Chamber of Agriculture, Proceedings.
Ceylon, Planters' Association, Year Book.
Chartered Institute of Patent Agents, Transactions.
Chartered Institute of Secretaries, "The Secretary."
Chemical Society, Journal.
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———, Field Columbian Museum, Publications.
Civil and Mechanical Engineers' Society, Transactions.
Cleveland Institution of Engineers, Proceedings.
Cold Storage and Ice Association, Proceedings.
Cornell University, Physical Review.
East India Association, Journal.
Farmers' Club, Journal.
Franklin Institute, Journal.
Geneva, Société des Arts, Bulletin de la Classe d'Industrie et de Commerce.
Geological Society, Quarterly Journal.
Glasgow Philosophical Society, Proceedings.
Haarlem, Koloniaal Museum, Bulletin.
Imperial Department of Agriculture for the West Indies, Publications.
Imperial Institute, Bulletin.
India, Geological Survey, Memoirs and Palæontologia Indica.
India, Government of, Agricultural Ledger.
Indian Meteorological Department, Memoirs.
Institute of Architects of New South Wales, Journal.
Institute of Bankers, Journal.
Institute of Chemistry, Proceedings.
Institution of Civil Engineers, Minutes of Proceedings.
Institution of Civil Engineers of Ireland, Transactions.
Institution of Electrical Engineers, Journal.
Institution of Engineers and Shipbuilders in Scotland, Transactions.
Institution of Gas Engineers, Transactions.
Institution of Mechanical Engineers, Proceedings.
Institution of Mining and Metallurgy, Transactions.
Institution of Naval Architects, Transactions.
International Catalogue of Scientific Literature.
Iron and Steel Institute, Journal.
Japan, College of Science, Imperial University, Journal.
Japan Society, Transactions and Proceedings.
Junior Institution of Engineers, Record of Transactions.
Kew Gardens Bulletin.
Linnæan Society, Journal.
Liverpool Engineering Society, Transactions.
Liverpool Literary and Philosophical Society, Proceedings.
London Chamber of Commerce, Journal.
Manchester Literary and Philosophical Society, Memoirs and Proceedings.
Manchester Steam Users' Association, Reports.
Munich, Polytechnische - Verein, Bayerisches Industrie-und-Gewerbeblatt.
National Association for the Promotion of Technical and Secondary Education, "Record."
National Indian Association, "The Indian Magazine and Review."
National Service League, Journal.
New South Wales, Royal Society, Journal and Proceedings.
New York Academy of Sciences, Annals and Memoirs.
North-East Coast Institution of Engineers and Shipbuilders, Transactions.
Nova Scotian Institute of Science, Transactions.
Odontological Society, Transactions.
Paris, Comité International des Poids et Mesures, Procès Verbaux.

Paris, Conservatoire National des Arts et Métiers, Annales.
——, Société d'Encouragement pour l'Industrie Nationale, Bulletin.
——, Société de Geographie Commerciale, Bulletin.
——, Société Internationale des Electriciens, Bulletin.
——, Société Nationale d'Acclimatation de France, Bulletin.
Patent-office, Illustrated Official Journal.
Pennsylvania (Western), Engineers' Society of, Proceedings.
Pharmaceutical Society, The Pharmaceutical Journal.
Philadelphia, Academy of Natural Sciences, Proceedings.
————, Engineers' Club, Proceedings.
Physical Society, Proceedings.
Quekett Microscopical Club, Journal.
Rome, Associazione Elettrotecnica Italiana, Atti.
Röntgen Society, Journal.
Royal Agricultural Society, Journal.
Royal Asiatic Society, Journal.
Royal Astronomical Society, Memoirs.
Royal Colonial Institute, Proceedings.
Royal Cornwall Polytechnic Society, Annual Report.
Royal Geographical Society, "The Geographical Journal."
Royal Horticultural Society, Journal.
Royal Institute of British Architects, Journal.
Royal Institution of Cornwall, Journal.
Royal Institution of Great Britain, Proceedings.
Royal Irish Academy, Transactions and Proceedings.
Royal Meteorological Society, Quarterly Journal and Record.
Royal National Life Boat Institution, "The Life Boat" and Annual Report.
Royal Photographic Society of Great Britain, "The Photographic Journal."
Royal Scottish Society of Arts, Transactions.
Royal Society, Philosophical Transactions and Proceedings.
Royal Society of Edinburgh, Transactions and Proceedings.
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Society of Biblical Archæology, Proceedings.
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Society of Dyers and Colourists, Journal.
Society of Engineers, Transactions.
Society of Public Analysts, "The Analyst."
South Wales Institute of Engineers, Proceedings.
Tramways and Light Railways Association, Official Circular.
Victoria Institute, Journal of the Transactions.
Wisconsin Academy of Sciences, Transactions.

JOURNALS.

Weekly.

Amateur Photographer.
American Architect and Building News.
American Gas Light Journal.
American Machinist.
Architect.
Automobile Club Journal.
Automotor.
Board of Trade Journal.
Bradstreet's.
British Architect.
British Journal of Photography.
Builder.
Building News.
Cabinet Maker and Art Furnisher.
Chemical News.
Chemist and Druggist.
Chronicle (Montreal).
Colliery Guardian.
Cosmos: Revue des Sciences
Draper.
Economist.
Electrical Engineer.
Electrical Industries.
Electrical Review.
Electrical Times.
Electrician.
Electricity.
Engineer.
Engineering.
Engineering News (New York)
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English Mechanic.
Gardeners' Chronicle.
Gardening World.
Graphic.
Grocer.
Indian Engineering.
Industrial Motor Review.
Iron and Coal Trades Review
Journal of Gas Lighting.
Lancet.
Local Government Officer.
Mechanical Engineer.
Medical Press and Circular
Millers' Gazette.
Mining Journal.
Moniteur Industriel.
Musical Standard.
Nature.
Notes and Queries
Page's Weekly.
Photographic News.
Photography.
Practical Engineer.
Produce Markets' Review
Queen.
Railway Times.

Review of the River Plate.
Revue Industrielle.
Sanitary Record.
Saturday Review.
Science.
Scientific American.
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Textile Mercury

Fortnightly.

Agricultural News (Barbados).
Brewers' Gazette.
Corps Gras Industriels.
Finance Chronicle.
Irish Builder.
Jeweller and Metalworker.
Madrid Cientifico.
Perak Government Gazette.
Quinzaine Coloniale.
Railways (Calcutta).
Revue du Travail (Brussels).

Monthly.

American Exporter (New York).
Architectural Review.
Arms and Explosives.
Bookseller.
Brewers' Guardian.
Brewers' Journal.
British Trade Journal.
Building Societies' Gazette.
Caterer and Refreshment Contractors' Gazette.
Coach Builders' and Wheelwrights' Art Journal.
Cold Storage and Ice Trades Review.
Commercial America.
Concrete.
County Council and Agricultural Record.
Dyer and Calico Printer.
Educational Times.
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Engineering Magazine.
Engineering Review.
Estate Magazine.
Fotografia Artistica (Turin).
Foundry Trade Journal.
Giornale del Genio Civile (Rome).
Ice and Cold Storage.
Indian and Eastern Engineer.
Indian Review (Madras).
International Sugar Journal.
Investors Monthly Manual.
Irish Technical Journal.
Journal d'Agriculture Tropicale.
Journal d'Hygiène.
Knowledge.
Labour Co-partnership.
Leather Trades' Review.
Machinery Market.
Marine Engineer.
Mercantile Guardian.
Miller.
Mois Scientifique et Industriel.
Moniteur Scientifique.
Music.
Musical Times.
Oestereichische Monatsschrift für den Orient.
Paper Makers' Monthly Journal.
Paper Making.
Philosophical Magazine.
Photographic Times (New York).
Piano Journal.
Plumber and Decorator.
Pottery Gazette.
Process Engraver's Monthly.
Propriété Industrielle (Berne).
Revue Mineralurgique.
Science Abstracts.
Symons's Meteorological Magazine.
Textile Manufacturer.
Textile Recorder.
Textile World Record (Boston).
"Times" Index.
Watchmaker, Jeweller, and Silversmith.
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World's Carriers.

Quarterly.

Agricultural Journal of India.
Art Workers' Quarterly.
Edinburgh Review.
Quarterly Review.
Transvaal Agricultural Journal.
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NEWSPAPERS.

African World.
Banbury Advertiser.
Bombay Gazette (Overland Summary).
British Australasian.
Cape Times (Weekly Edition).
Ceylon Observer (Overland Edition).
Englishman (Calcutta).
Hindu (Madras).
Home and Colonial Mail.
London Commercial Record.
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Madras Weekly Mail.
Newcastle Weekly Chronicle.
Nottinghamshire Guardian.
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